60p

OUR COMPUTER

JULY 1982

Vol.2 No.7

Spectrum graphics and sound

Reviews:

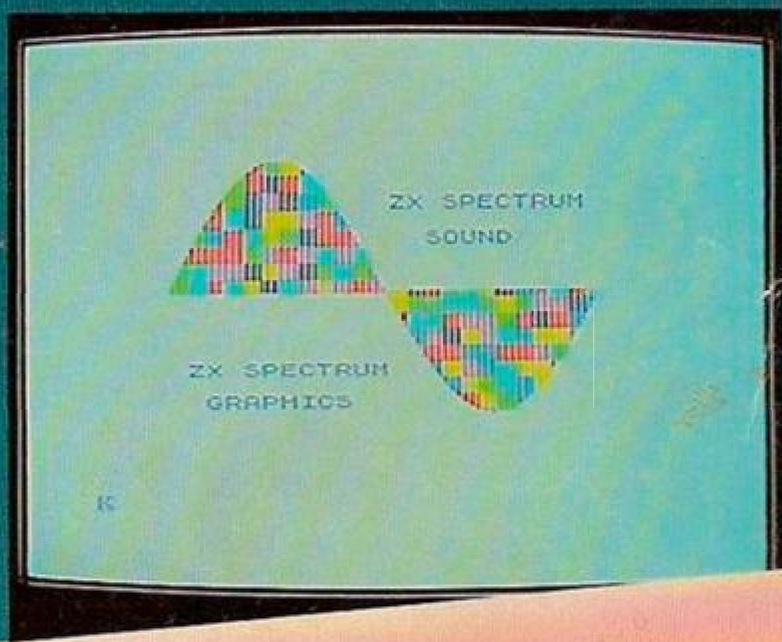
ZX-81 colour board

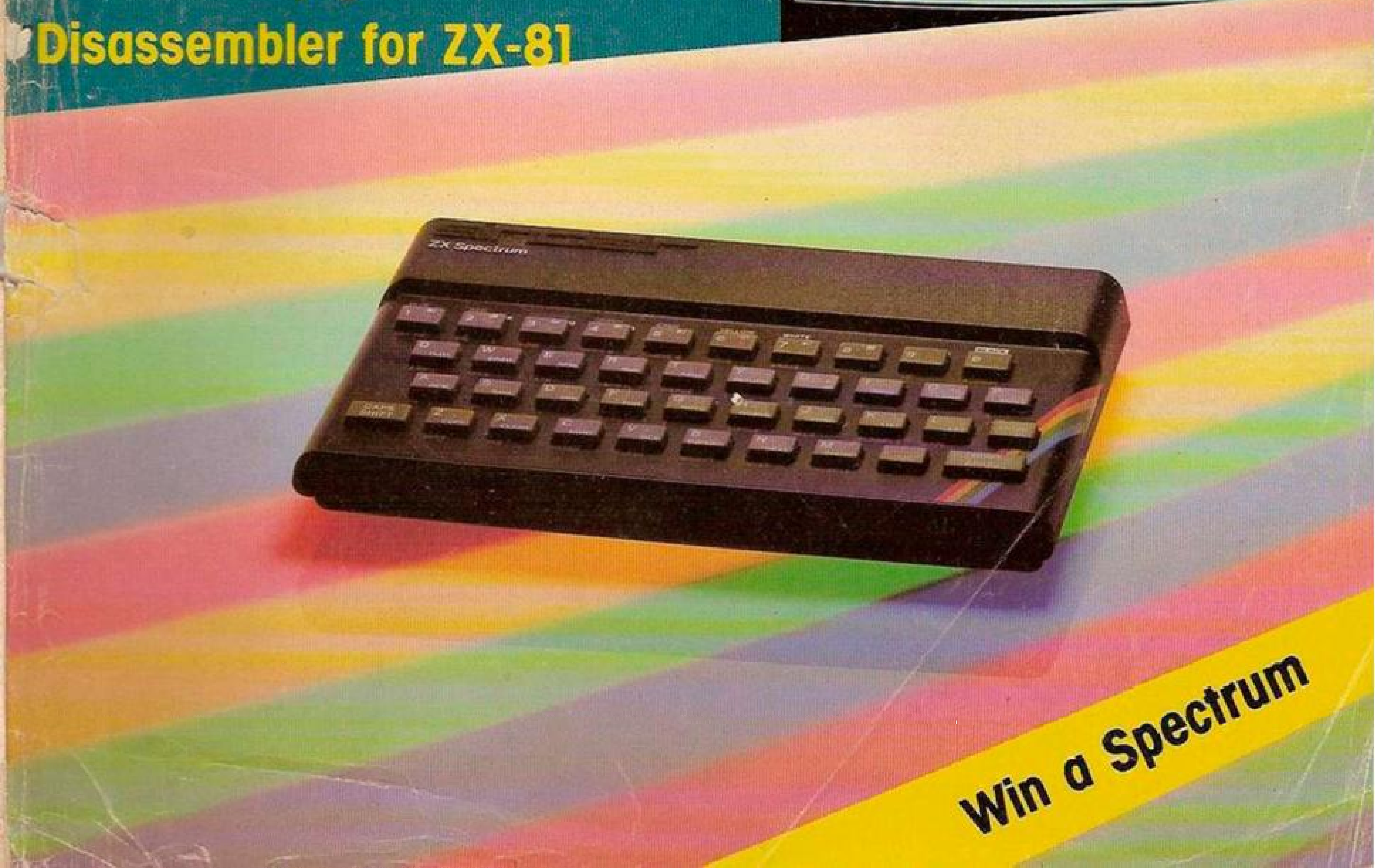
Atom software

Generating BBC sound

Vic memory game

Disassembler for ZX-81





Win a Spectrum

YOUR COMPUTER

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EDITORIAL

At the current rate of progress, "delayed deliveries for all" could soon be the first law of the microcomputing industry. Every week would-be buyers of micros, add-ons and software are sent down for the minimum stretch of two months before the goods arrive. Afterwards they are expected to be grateful for the leniency of this light sentence and forget about the whole ordeal. Others are not so lucky.

Apart from the damage to public relations, the only penalty facing a company which fails to deliver is finding a use for all the funds it has received. Some firms put customers' money into a trust account until the individual order has been fulfilled. However no company is obliged by law to do this.

A Private Member's Bill which has recently had its first reading would make trust accounts obligatory, but the Supply of Goods and Services Bill is unlikely ever to find its way on to the statute books. In any case trust accounts are no guarantee of prompt delivery.

In America companies must be able to show that goods are ready for despatch before they advertise them — a few pre-production models or prototypes are not sufficient. In certain cases in the UK the money you send with your order is the finance the company needs to set manufacture of the product under way. This is borne out by the recently-released Cork Committee Report which states that the customer who sends money is extending credit to the company in the same way that the wholesaler extends credit to the retailer.

If that is the official view one can hold out little hope that British law will change for the better.

If matters cannot be improved legally, one could at least hope that manufacturers might appreciate that consumers have made the UK the number one market in Europe — and start treating them with respect. Microcomputer enthusiasts should not be reduced to writing "time is of the essence" letters. The industry could start by ensuring that their telephone lines are no longer permanently engaged, that letters are swiftly answered, and that all sales staff at least use the same story to explain why delivery is delayed. ■

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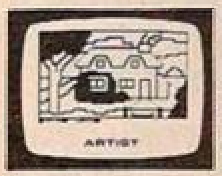
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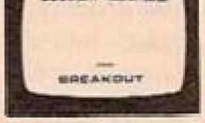




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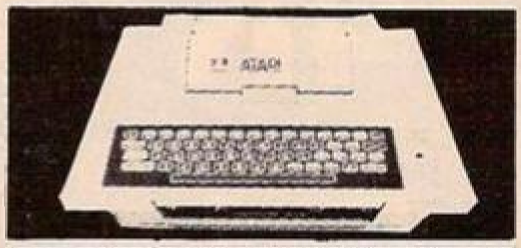


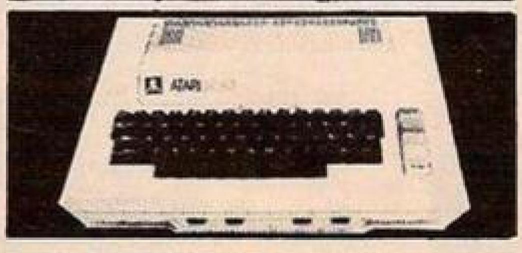
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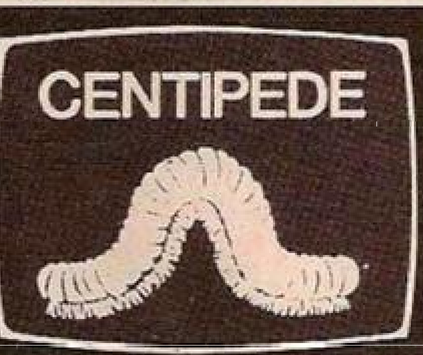
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Games

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Hardware required – ZX81.
Price – £4.95.
Programs – Invasion from Jupiter. Skittles. Magic Square. Doodle. Kim. Liquid Capacity.
Description – Five games programs plus easy conversion between pints/gallons and litres.

Cassette G2: Super Programs 2 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Rings around Saturn. Secret Code. Mindboggling. Silhouette. Memory Test. Metric conversion.
Description – Five games plus easy conversion between inches/feet/yards and centimetres/metres.

Cassette G3: Super Programs 3 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Train Race. Challenge. Secret Message. Mind that Meteor. Character Doodle. Currency Conversion.
Description – Fives games plus currency conversion at will – for example, dollars to pounds.

Cassette G4: Super Programs 4 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Down Under. Submarines. Doodling with Graphics. The Invisible Invader. Reaction. Petrol.
Description – Five games plus easy conversion between miles per gallon and European fuel consumption figures.

Cassette G5: Super Programs 5 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Martian Knock Out. Graffiti. Find the Mate. Labyrinth. Drop a Brick. Continental.
Description – Five games plus easy conversion between English and continental dress sizes.

Cassette G6: Super Programs 6 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Galactic Invasion, Journey into Danger. Create. Nine Hole Golf. Solitaire. Daylight Robbery.
Description – Six games making full use of the ZX81's moving graphics capability.

Cassette G7: Super Programs 7 (ICL)
Hardware required – ZX81.
Price: – £4.95.
Programs – Racetrack. Chase. NIM. Tower of Hanoi. Docking the Spaceship. Golf.
Description – Six games including the fascinating Tower of Hanoi problem.

Cassette G8: Super Programs 8 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Star Trail (plus blank tape on side 2).
Description – Can you, as Captain Church of the UK spaceship Endeavour, rid the galaxy of the Klingon menace?

Cassette G9: Biorhythms (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – What are Biorhythms? Your Biohythms.
Description – When will you be at your peak (and trough) physically, emotionally, and intellectually?

Cassette G10: Backgammon (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £5.95.
Programs – Backgammon. Dice.
Description – A great program, using fast and efficient machine code, with graphics board, rolling dice, and doubling dice. The dice program can be used for any dice game.

Cassette G11: Chess (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Chess, Chess Clock.
Description – Fast, efficient machine code, a graphic display of the board and pieces, plus six levels of ability, combine to make this one of the best chess programs available. The Chess Clock program can be used at any time.

Cassette G12: Fantasy Games (Psion)
Hardware required – ZX81 (or ZX80 with 8K BASIC ROM) + 16K RAM.
Price – £4.75.
Programs – Perilous Swamp. Sorcerer's Island.
Description – Perilous Swamp: rescue a beautiful princess from the evil wizard. Sorcerer's Island: you're marooned. To escape, you'll probably need the help of the Grand Sorcerer.

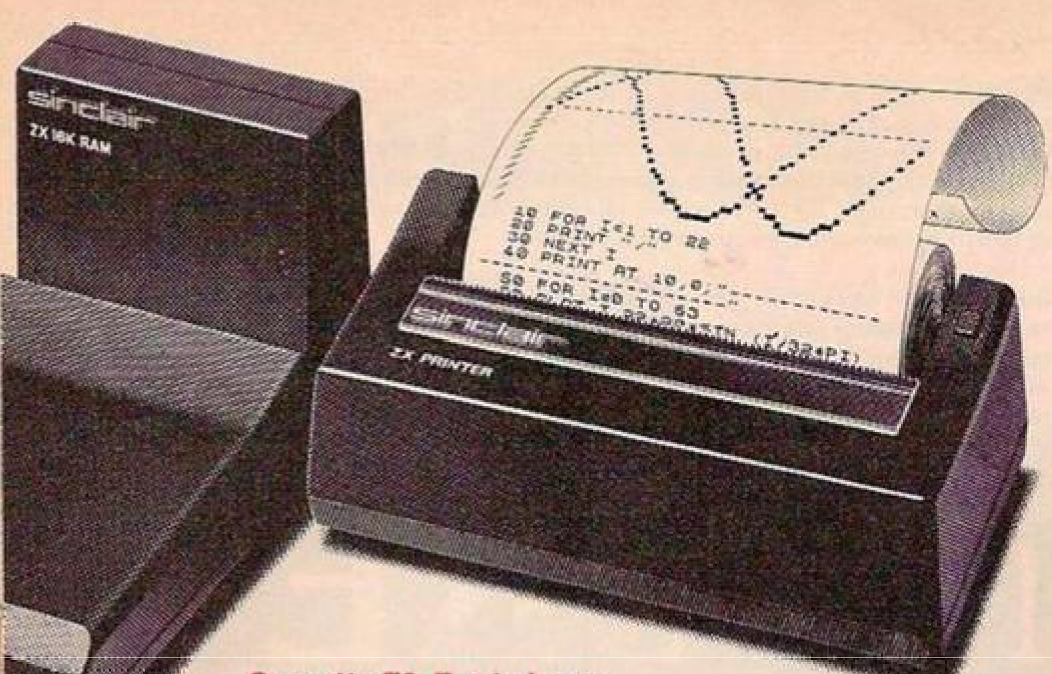
Cassette G13: Space Raiders and Bomber (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £3.95.
Programs – Space Raiders. Bomber.
Description – Space Raiders is the ZX81 version of the popular pub game. Bomber: destroy a city before you hit a sky-scraper.

Cassette G14: Flight Simulation (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £5.95.
Program – Flight Simulation (plus blank tape on side 2).
Description – Simulates a highly manoeuvrable light aircraft with full controls, instrumentation, a view through the cockpit window, and navigational aids. Happy landings!

Education

Cassette E1: Fun to Learn series – English Literature 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Novelists. Authors.
Description – Who wrote 'Robinson Crusoe'? Which novelist do you associate with Father Brown?

Cassette E2: Fun to Learn series – English Literature 2 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Poets, Playwrights. Modern Authors.
Description – Who wrote 'Song of the Shirt'? Which playwright also played cricket for England?



Cassette E3: Fun to Learn series – Geography 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Towns in England and Wales. Countries and Capitals of Europe.
Description – The computer shows you a map and a list of towns. You locate the towns correctly. Or the computer challenges you to name a pinpointed location.

Cassette E4: Fun to Learn series – History 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Events in British History. British Monarchs.
Description – From 1066 to 1981, find out when important events occurred. Recognise monarchs in an identity parade.

Cassette E5: Fun to Learn series – Mathematics 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Addition/Subtraction. Multiplication/Division.
Description – Questions and answers on basic mathematics at different levels of difficulty.

Cassette E6: Fun to Learn series – Music 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Composers. Musicians.
Description – Which instrument does James Galway play? Who composed 'Peter Grimes'?

Cassette E7: Fun to Learn series – Inventions 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Inventions before 1850. Inventions since 1850.
Description – Who invented television? What was the 'dangerous Lucifer'?

Cassette E8: Fun to Learn series – Spelling 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Series A1-A15. Series B1-B15.
Description – Listen to the word spoken on your tape recorder, then spell it out on your ZX81. 300 words in total suitable for 6-11 year olds.

Business/household

Cassette B1: The Collector's Pack (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £9.95.
Program – Collector's Pack, plus blank tape or side 2 for program/data storage.
Description – This comprehensive program should allow collectors (of stamps, coins etc.) to hold up to 400 records of up to 6 different items on one cassette. Keep your records up to date and sorted into order.

Cassette B2: The Club Record Controller (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £9.95.
Program – Club Record Controller plus blank tape on side 2 for program/data storage.
Description – Enables clubs to hold records of up to 100 members on one cassette. Allows for names, addresses, 'phone numbers plus five lots of additional information – eg type of membership.

Cassette B3: VU-CALC (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £7.95.
Program – VU-CALC.
Description – Turns your ZX81 into an immensely powerful analysis chart. VU-CALC constructs, generates and calculates large tables for applications such as financial analysis, budget sheets, and projections. Complete with full instructions.

Cassette B4: VU-FILE (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £7.95.
Programs – VU-FILE. Examples.
Description – A general-purpose information storage and retrieval program with emphasis on user-friendliness and visual display. Use it to catalogue your collection, maintain records or club memberships, keep track of your accounts, or as a telephone directory.

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	G3: Super Programs 3	32	£4.95	
	G4: Super Programs 4	33	£4.95	
	G5: Super Programs 5	34	£4.95	
	G6: Super Programs 6	35	£4.95	
	G7: Super Programs 7	36	£4.95	
	G8: Super Programs 8	37	£4.95	
	G9: Biorhythms	38	£6.95	
	G10: Backgammon	39	£5.95	
	G11: Chess	40	£6.95	
	G12: Fantasy Games	41	£4.75	
	G13: Space Raiders & Bomber	42	£3.95	
	G14: Flight Simulation	43	£5.95	
	E1: English Literature 1	44	£6.95	

Qty	Cassette	Code	Item price	Total
	E2: English Literature 2	45	£6.95	
	E3: Geography 1	46	£6.95	
	E4: History 1	47	£6.95	
	E5: Mathematics 1	48	£6.95	
	E6: Music 1	49	£6.95	
	E7: Inventions 1	50	£6.95	
	E8: Spelling 1	51	£6.95	
	B1: Collector's Pack	52	£9.95	
	B2: Club Record Controller	53	£9.95	
	B3: VU-CALC	54	£7.95	
	B4: VU-FILE	55	£7.95	
	ZX 16K RAM pack	18	£29.95	
	ZX Printer	27	£59.95	
	Post & packing – *only* if ordering hardware		£2.95	

TOTAL £ ____

I enclose a cheque/postal order to Sinclair Research Ltd for £ ____

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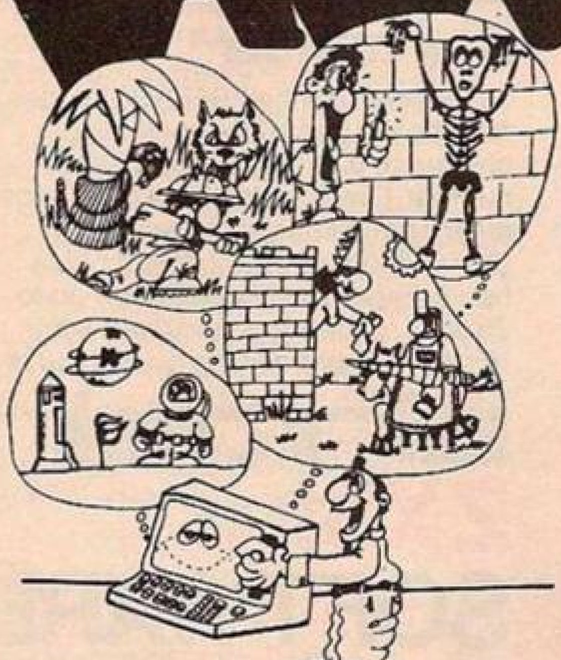
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YOUR LETTERS

CHESS FALLACY

I enjoyed John White's article on Chess in May's *Your Computer*. However, there is a fallacy in the article. White gives as one reason for programming in machine code the inability of Basic to perform recursion. Whatever the other reasons for programming in machine code it is certainly not universally true that Basic will not support recursion. Recursion is supported by Sharp Basic on the Sharp MZ-80K. Consider the following simple program, for example:

```
10 A=0
20 GOSUB 100
30 PRINT A
40 END
100 A=A+1
110 IF A<4 THEN GOSUB 100
120 A=A+A
130 RETURN
```

The MZ-80K happily runs this program obtaining the correct value of 64 for A. If the Gosub in line 110 is replaced by Goto the final value of A is only 8. The MZ-80K will accept 15 levels of subroutines and it does not seem to matter even if they are all the same one. John's lapse is all the more surprising since his excellent articles suggest that he uses a Sharp MZ-80K.

Alan Stevens,
Alvaston,
Derby.

MISCAST RUNES

While entering "Cast the Runes" from the May edition of *Your Computer*, I found two errors. A semi-colon was missing in line 1050. After the line number a semi-colon is required before LN. Also, line 1130 should read:

```
A=ASC (C$):A=A -64: IF A>26 OR
  A<1 THEN PRINT 4 etc.
```

You printed a zero instead of an 'o' in the word or, which as it was jammed up against another number, made things very confusing. Congratulations on a great magazine. Keep it up.

John Bell,
Quandon,
Derby.

PURSUIT PRAISE

SA Nicholls has struck again! I spent 1½ hours cautiously entering the Hot Pursuit program, from March Software File, in hexadecimal.

The game was a revelation — responsive, fast, flicker free and what a finale. Could I humbly suggest saving the program in segments — e.g., 16514, 16678, 16574, 16835, 16514 and 16971. There are two reasons for this. Firstly it is very tiring keying in with such concentration. Secondly if a lead comes loose, then a backup is near to hand. Name the Saves as "PART", "PART 2", "MAZE". Do not forget that if loading one of the saves, such as "PART 2" that the Let statement in line 10 should be updated, that is Let X = 16836. Prior to saving the last segment change to Slow. Otherwise it is annoying to change it after every load. But this is nit picking — once again congratulations to S A Nicholls.

David Miskimin,
Astley,
Manchester.

TURNING TABLES

I own a 1K Sinclair ZX-81 and was very much impressed by Charles Chambers' article "How to impress with your ZX-81", in May's issue. Although the majority of the programs ran smoothly, I came across a hitch with Program 3 creating the children's multiplication tables. On running, the program provided a series of numbers which continued until the memory was full but not the expected tables. As a result, I turned my hand to writing a simple 1K program for the tables. It runs as follows:

```
5 REM TABLES *12 BY H CORRIN,
  1982.
10 LET Y=1
20 LET X=1
30 PRINT X;" X ";Y;" = ";X*Y
40 LET X=X+1
50 IF X=13 THEN GOTO 70
60 GOTO 30
70 PAUSE 300
80 CLS
90 LET Y=Y+1
100 IF Y=13 THEN GOTO 120
110 GOTO 20
120 STOP
```

Howard Corrin,
Harrogate,
North Yorkshire.

BBC ROM BUG

I have made a rather odd discovery. The BBC, unlike the Pet or 380-Z, does not set all variables to zero when it is switched on; thus if one types "PRINT A" the machine will reply apologetically "No such variable". However, if one types "LET A = A", without predefining A, it does not give an error message. In fact, if one types "PRINT A" it now contains 0. If this is not intended on Acorn's part, do I have the honour of finding the first, and hopefully the only, bug in the BBC's ROM?

Simon Pick,
Eskdaleside,
North Yorkshire.

KEYBOARD SURVEY

Of the many hundreds of Protos keyboards we have sold, the one reviewed in the June survey was the first to suffer damage in the post. It may be a coincidence, but this was the first to be sent by first-class post.

I would also like to point out some factual inaccuracies in the article. First, the Protos does not require soldering to the ZX-81 board, as may be construed from the fact that it was not included among those that do not. The keyboard is fitted with a copy of the ZX-81 connector which pushes into the ZX-81 keyboard socket. This is not a ribbon cable but an industrial flexible connector costing about 60 times that of ribbon cable.

Secondly, the key legends are not only very legible, but are an enormous improvement on the Sinclair-style ones. The problem of colour blindness is one which is of concern to all manufacturers, but cannot be the over-riding factor in use of colour. The same criticism could be levelled at countless others — including Sinclair with the Spectrum keyboard.

As for being "awkward to use" we have found that the use of an index finger pressed on one of the keytops has the same effect on the Protos keyboard as on any other keyboard. However, as the manufacturers of the key-switches we use assure us that they are good for up to 10 million or so operations you would be able to press your key-switch for about 20 times as long as the majority of other manufacturers' boards made for the ZX-81.

Mike Mepham,
Protos,
Frome, Somerset.

BBC ON SPEC

I wonder if BBC micro owners have noticed the many differences between the hardware and the expensive and detailed BBC specification. The PAL encoded video output will not work unless you add a 470pF capacitor to the board to connect the PAL encoder to the video output circuit. The Break key has not been put on the back as specified but is alongside the function and cursor-control keys, and can be hit accidentally; however Old will restore the status quo, and the key can be programmed as *Key10. The Centronics interface drawing in the manual is inaccurate; the ACK connection having moved two places closer to the Data lines, and the interpreter is in EPROM.

Nevertheless, after a month's hard use I can honestly say that the Beeb is the best and most versatile micro I have used, and very user-friendly. After a hard night's programming you can always fry your breakfast bacon and eggs on the power supply.

Geoff Cox,
Gillingham,
Kent.

ZX-81 SOFTWARE

Last month you did a survey of ZX-81 software, and were unable to load Monster Maze. What a pity, as it was the finest piece of software in your selection. If I may be so bold as to rate it for you:

A	B	C	D	E	F	G	H
-	3	5	5	-	5	5	5

I noticed an article on the Vic-20 in the May issue, in which the marketing manager said: "75 percent of ZX owners had exhausted the possibilities of their machines". I have been attempting to exhaust the possibilities of my ZX-81 for almost a year. The more I find out, the more there is to know. I thought I was almost familiar with its workings, but since our Cardiff ZX-81 club formed we have discovered ways of scrolling the listings, and producing new graphics.

When my Sinclair Spectrum arrives I intend to interface it to my old ZX-81.

Mike Hayes,
The '81 Club,
Grangetown,
Cardiff.

RESISTANCE

I encountered a few problems with the Resistor Finder on page 79 of the May issue on entering it into a Vic-20.

A resistor of colours Red, Red, Black is 22 ohms, that is 2, 2, MULTIPLIER. ONE and the result was a zero. In the resistor colour code bands 1 and 2, if black are zeros, but if band 3 is black, it is a multiplier of Value 1.

I changed the following lines:

```
270 IF A$ = "BLACK" THEN A = 0
271 IF B$ = "BLACK" THEN B = 0
272 IF C$ = "BLACK" THEN C = 1
 15 PRINT " " (Clear Screen)
195 INPUT "PRESS RETURN";X$
140 )
155 ) Deleted
190 )
196 GOTO 15
```

Line 20 change TAB (165) to: TAB (155) for formatting.

I am new to computing so I hope I have not overlooked anything.

Anthony Roland,
Northwich,
Cheshire.

MONITOR BYTE

There is an error in John Sylvester's machine-code monitor program for the ZX-81 which appeared in the June issue. The byte at address 40B7, listed as 84, should in fact be 8A. With this amendment, the program runs perfectly.

D F Hewin,
Tamworth,
Staffordshire.

JOYSTICK SHORT

I have received several letters about my article "The ZX-81 under joystick control — build your own" in the May issue. They brought to my notice a mistake in figure 1, which will cause the joystick to short.

The four bolts which secure the four copper plates to the joystick should be substituted with screws, which will screw halfway into the wooden blocks, so eliminating the problem. An alternative solution is to insulate the bolts from the upper plates with small rubber washers.

David Griffin,
Warley,
West Midlands.

Your NewBrain is ready now



THE NEWBRAIN microcomputer has finally arrived, two years after it was first announced. Grundy acquired the project from Newbury Laboratories last summer. The model A costs £233 and is based on a Z-80A microprocessor. It includes 32K RAM, 29K ROM, high resolution graphics and a dual cassette port. Other features include V24 bi-directional and printer ports, a TV port and 80 by 30 character line video. An external mains power pack, leads and user handbook are included in the price.

Plug-in memory expansion modules are available with either 64K, 128K, 256K or 512K of RAM. Four 512K modules can be linked to the NewBrain at any one time, giving more than two megabytes of memory.

The NewBrain uses an enhanced Ansi Basic dynamic compiler rather than an interpreter. This allows full user-proofing of programs, direct interrupt handling, chaining and external calls. The editor contains backwards scrolling, multi-screens and direct cursor addressing.

An AD model NewBrain is also available for £267.50. It includes a blue-green vacuum fluorescent 16-character, 14-segment display. Other models planned for release later this summer will feature two additional V24 bi-directional ports, 8-bit parallel I/O ports and five analogue ports.

More detailed information about the NewBrain is available from Grundy Business Systems Ltd, Cambridge Science Park, Milton Road, Cambridge. Telephone: 0223 350355.

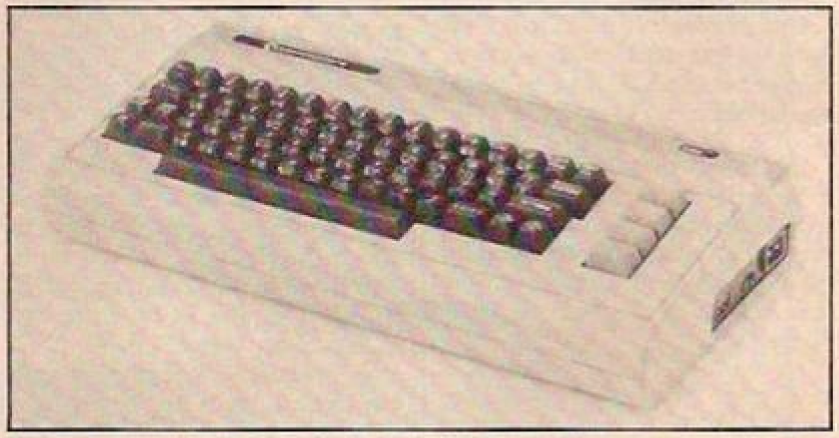
Apple Logo first on micro

APPLE LOGO, a learning language specifically designed to teach computer programming and problem solving skills, will be on show in Britain for the first time at the National Education and Training Exhibition at the NEC in Birmingham on July 6-8. This is the first time Logo has been professionally implemented on a microcomputer, says Apple. Demonstrators on the Apple stand will show how Apple Logo can be used to increase computer literacy.

Presfax 100 consists of a 15in. square keypad which can be placed over the graphics tablet to give 100 touch sensitive keys. Designed by DMS Electronics, Sheffield, Presfax can be used to help handicapped people overcome some of the limitations of the conventional keyboard. Alpha-numeric or braille characters can be used as overlays on the keys, for example.

More information from Apple Computer (U.K.) Ltd, Finway Road, Hemel Hempstead, Hertfordshire HP2 7PS. Telephone: 0442 48151.

Commodore blitz market with Vic 10, Vic 30 and Commodore 64



THE LATEST Commodore microcomputers were shown in the U.K. for the first time at the Commodore Computer Show in London on June 3-5. The Vic-10 is a bottom-of-the-range games computer and music synthesiser. A 6566 video chip allows three dimensional graphics while a SID chip allows for three voices, each with a nine octave range.

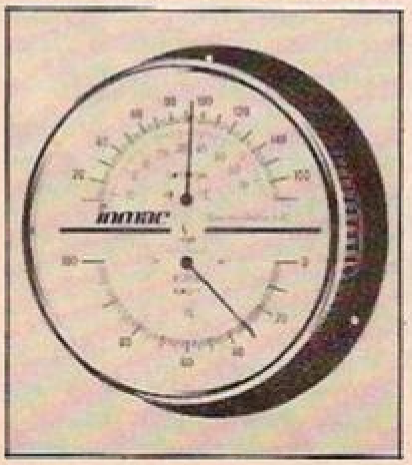
Main features of the Vic-10 are a 40 by 25 colour text screen, high resolution colour graphics, 2K RAM and facilities for plug-in games cartridges, joysticks, paddles and light pen. The Vic-10 does not have built-in Basic, but a mini Basic cartridge is available. The Vic-10 costs £100 and should be available from September.

The next newcomer in the Commodore range is the Vic-30. This uses the same 6566 chip as the Vic-10, but it includes 16K of usable RAM and a 20K ROM built-in operating system. This machine is compatible with existing Vic-20 peripherals such as the 1540 disc drive, the Vic cassette and the 1515/1525 printers. Priced at £250, the Vic-30 is expected to go on sale in January 1983.

The Commodore 64 bears a remarkable resemblance to the Vic-30. The main differences are that the Commodore 64 has 64K RAM and is capable of accepting a second processor such as a Z-80 to run CP/M. In addition, the Commodore 64 memory map can be rearranged to allow the use of software written for other Commodore 40 column machines. The Commodore 64 costs £400 and should be available from October.

For further information contact Commodore, 675 Ajax Avenue, Slough, Berkshire. Telephone: 0753 79292.

A combined temperature/humidity meter designed to monitor computer operating conditions has been released by Inmac. The most suitable range of operating temperatures lies between 17° and 21°C. If heat builds up, then chips can fail. Likewise, if relative humidity exceeds 60 percent, short-circuits can occur. The meter costs £50 from Inmac (U.K.) Ltd, 18 Goddard Road, Astmoor Industrial Estate, Runcorn, Cheshire WA7 1QF. Telephone: 09285 67551.



Cassette three

CASSETTE THREE is the latest in a series of games programs for the 16K ZX-81 produced by Michael Orwin. The programs include Starship Trojan, Startrek, Princess of Kraal and Martian Cricket. Battle is a game for up to four players. The object is to capture all the enemy bases while retaining your own, but watch out for incoming missiles. Cassette three costs £5 from Michael Orwin, 26 Brownlow Road, Willesden, London NW10 9QL.

Sound and colour as Dragon launch 32K micro

DRAGON DATA is launching a new 32K RAM family computer with real keyboard, colour, graphics and sound for £200.

Dragon claims that the 6809E-based microcomputer is mainly British built, with components manufactured by Motorola in East Kilbride and final assembly in Swansea.

The Dragon 32 should be in the shops at the beginning of August. The standard machine features high-resolution graphics, nine colours, point-by-point drawing, lines, arcs, and 3D capability. The sound specification offers 255 tones and 31 volume levels.

A comprehensive range of add-ons is planned by Dragon, which is part of the Mettoy group. A disc operating system, serial RS232 port and Prestel facility should be available in the next year.

In the meantime the Dragon 32 has connections for joystick, cassette recorder, games cartridges and printer.

Further information from Dragon Data, Queensway, Swansea Industrial Estate, Swansea SA5 4EH.



Scottish show

EDINBURGH COMPUTER CLUB is holding a ZX computer show at Meadowbank Stadium, Edinburgh, on Saturday July 24. The first show of its kind to be held in Scotland, it will be open to the public from 10am to 6pm. Admission will be 50p for adults and 25p for children.

About 30 companies are expected to exhibit at the show. More information from Edinburgh ZX Club, c/o G W Hewit, 3 Baberton Mains View, Edinburgh EH14 3BR, by July 1.

Artic's Zilog dissassembler

ZXBUG, a machine code monitor and debugger with full Zilog disassembler, has been launched by Artic Computing. The program, which is just under 4K long and resides at the top of the 16K ZX-81's memory, has 30 commands that allow you enter messages in normal or reverse field video.

The program also enables you to search through a block of memory for any occurrence of a byte or word. These can then be replaced by any other byte.

A Z-80 Zilog mnemonic disassembler allows you to display a page at a time. ZXBug costs £7 from Artic Computing Ltd, 396 James Reckitt Avenue, Hull, North Humberside.

Spectrum delays

AFTER ALL THE DELAYS in the last two months Spectrum deliveries have begun in earnest.

It has taken eight weeks for Sinclair Research to deliver the machines ordered in the first few days after the launch.

The initial demand was higher than expected and problems gearing up production, together with a circuit design fault, set schedules back.

The company now claims that the backlog has been cleared and that new orders will be fulfilled within four weeks.



Hamleys of Regent Street has opened a centre for microprocessor-based games and toys.

Among the games on display are Fidelity Chess, Checkers, Backgammon and Bridge Challengers. Computer Games Ltd, which has two games experts and demonstrators permanently available at the centre to advise prospective buyers, is showing the original series of Game & Watch pocket/purse LCD games on its stand at the Hamleys centre.

Other games include Galaxy 1000 and Galaxy 10,000, Earth Invader, Jetfighters, Gunfighters and Galaxy Twinvader.

The company's complete comprehensive range of microprocessor board, handheld, pocket and stand-alone console games are available for trial by the public.

Pride of place is currently held by Puck Monster — the eat or be eaten maze game that has swept the United States and Japan and now threatens Europe.



Educational Electronics and Bedfordshire Education Authority's Technology Unit have launched an interface unit for any eight-bit microcomputer. It can be used to control robot arms, hydraulic and pneumatic valves and stepper motors. Additional modules include a joystick and a speaker box. More information from Educational Electronics, 7 Wood Street, Woburn Sands, Milton Keynes, Buckinghamshire MK17 8PH. Telephone: 0908 584134.

Easy plotting

A GRAPHIC PLOTTER for the ZX-81 produced by Ad-Lib consists of a double-sided card with screen grids and co-ordinates. One side of the card is designed for use with Print statements while the other side caters for Plot statements. When the display is complete, the graphic plotter can be cleaned with a damp cloth and re-used. A pack of five graphic plotters and a special pen is available from Ad-Lib for £2.50. A pack with coloured pens for use with the new ZX Spectrum costs £4.75. More details from Ad-Lib, 2A Grovelands Avenue, Hitchin, Hertfordshire. Telephone: 0462 56074.

Bargain Bytes back

BARGAIN BYTES TWO is the second cassette of programs for the 16K ZX-81 from Richard Shepherd. It consists of eight programs varying from a stock-market simulation-game to a financial-modelling program. Seafaring Adventure is an adventure game set in the Mediterranean Sea in the last century. You are a Royal Navy officer. If you sink enemy vessels you will be promoted. The game ends when you are made First Sea Lord. Other games include a moving-graphics Ski Run, Noughts and Crosses and a General Knowledge Quiz.

One feature of the cassette is a test program to help overcome loading problems. Before loading any of the other programs, you load "Test" which takes 25 seconds. If the volume controls on your cassette recorder are set correctly, "Program OK" will appear on the screen.

Bargain Bytes Two costs £5 including postage and packing from Richard Shepherd, 22 Green Leys, Maidenhead, Berkshire SL6 7EZ. Telephone: 0628 21107. ■

MICHAEL ORWIN'S ZX81 CASSETTES

QUOTES

"Michael Orwin's £5 Cassette Two is very good value. It contains 10 stolid well designed games which work, offer plenty of variety and choice, and are fun."
from the ZX Software review in Your Computer, May '82 issue.

"I had your Invaders/React cassette ... I was delighted with this first cassette."
P. Rubython, London NW10

"I have been intending to write to you for some days to say how much I enjoy the games on 'Cassette One' which you supplied me with earlier this month."
E. H., London SW4

"I previously bought your Cassette One and consider it to be good value for money!"
Richard Ross-Langley
Managing Director
Mine of Information Ltd.

CASSETTE 1
(eleven 1K programs)

machine code:
React, Invaders, Phantom aliens, Maze of death, Planet lander, Bouncing letters, Bug splat.

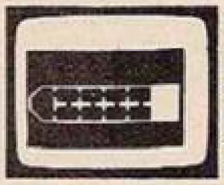
Basic:
I Ching, Mastermind, Robots, Basic Hangman. PLUS Large screen versions of Invaders and Maze of Death, ready for when you get 16K.
Cassette One costs £3.80.

CASSETTE 2
Ten games in Basic for 16K ZX81

Cassette Two contains Reversi, Awari, Laser Bases, Word Mastermind, Rectangles, Crash, Roulette, Pontoon, Penny Shoot and Gun Command.
Cassette Two costs £5.

CASSETTE 3
8 programs for 16K ZX81

STARSHIP TROJAN

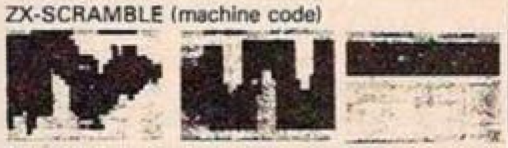


Repair your Starship before disaster strikes. Hazards include asphyxiation, radiation, escaped biological specimens and plunging into a Supernova.

STARTREK This version of the well known space adventure game features variable Klingon mobility, and graphic photon torpedo tracking.
PRINCESS OF KRAAL An adventure game.
BATTLE Strategy game for 1 to 4 players.
KALABRIASZ World's silliest card game, full of pointless complicated rules.
CUBE Rubik Cube simulator, with lots of functions including 'Backstep'
SECRET MESSAGES This message coding program is very txlp qexi jf.
MARTIAN CRICKET A simple but addictive game (totally unlike Earth cricket) in machine code. The speed is variable, and its top speed is very fast.
Cassette 3 costs £5.

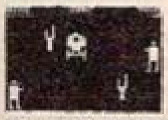
CASSETTE 4
7 games for 16K ZX81

ZX-SCRAMBLE (machine code)

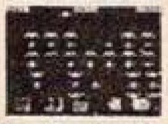


Bomb and shoot your way through the fortified caves.

GUNFIGHT (machine code)



INVADERS (machine code)



GALAXY INVADERS (machine code)
Fleets of swooping and diving alien craft to fight.

SNAKEBITE (machine code)
Eat the snake before it eats you. Variable speed (very fast at top speed)

LIFE (machine code)
A ZX81 version of the well known game.

3D TIC-TAC-ONE (Basic)
Played on a 4×4×4 board, this is a game for the brain. It is very hard to beat the computer at it.

6 of the 7 games are in machine code, because this is much faster than Basic. (Some of these games were previously available from J. Steadman).

Cassette 4 costs £5.

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MICROCOMPUTER CASSETTE

Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. We would like to hear of anything which has made your club a success, or of any projects or programs you are developing.

FINDING FAULTS IN NEWPORT





Alan Beale (left) using an oscilloscope to diagnose faults on an Atom, while Jim Billinghurst (above) demonstrates his Microtan.

How much would a ZX-81 have cost you 20 years ago — and what use is an oscilloscope to micro enthusiasts? Meirion Jones visited the Gwent Amateur Computer Club to find out.

SPRAWLING NEWPORT — where the river Usk tips into the Severn — is not everyone's idea of Silicon Valley. Nevertheless, there are few areas in Britain which host such a range of microelectronics industries, ranging from chip design and manufacture through to final assembly of computers.

Not far from the new Inmos plant, local micro enthusiasts gather every Wednesday evening at the Bryn Glas community centre. This is the sixth meeting-place the Gwent Amateur Computer Club has had to find in the four years since it was founded. Early in the Club's career, British Steel presented it with a vintage English Electric KDN-2 once used in Llanwern, which puts the capabilities of today's micros into perspective.

The KDN-2 was less powerful and incomparably slower than a ZX-81. Although it occupied as much space as a family car, back in 1962 it could be described as "a small machine". All this was available at the "relatively low price" of £20,000.

Club members run Atoms, BBCs, Microtans, Nascoms, Sharps and Tandys as well as a Sorcerer, a Transam, a TI-99/4 and a few Sinclairs. Since they have such a wide range of machines the club has concentrated on building up hardware expertise particularly about chips which are common to several different micros, rather than software which may not be portable. Several members have utilised this knowledge to build their own one-off specials based around the Z-80 microprocessor.

When *Your Computer* visited the club, a typical meeting was in progress. Before the coffee break Jim Billinghurst demonstrated the virtues and vices of his home-built Microtan, including a concealed reset button to prevent his young children wiping out half-entered programs.

Later Alan Beale, a founder member, demonstrated fault-finding on an Acorn. Geoff Price, the treasurer, had noticed that his Atom was printing rubbish on parts of the screen. After extricating the board from its heavy-duty Powertran case, Alan Beale made judicious use of circuit map and oscilloscope to identify which chip was the source of the problem.

Whereas a professional repair would have been very costly, by using the know-how of the club Geoff Price was able to restore his Atom to full working order for less than £1 — the price of a new 2114 RAM chip.

The Gwent club's fortunes have fluctuated over the last four years. Membership has been as high as 100 and as low as 20. Secretary Ian Hazel produces a monthly newsletter detailing the forthcoming meetings arranged by Les Trigg the events secretary. Under the chairmanship of Rhodri Harris, and with a secure base now at Bryn Glas, the club is growing again. More information is available from Geoff Price on Cwmbran 69750. ■

Local society news

West Sussex Sinclairs

SINCLAIR OWNERS in Bognor Regis were given £75 by Arun District Council to set up a Computer club. They now meet on the second Thursday of every month at the Regis Centre in Bognor. Subscription is £5 a year, or £2 for the under-16s. Meetings take the form of a demonstration followed by practical "hands-on" experience for the members. Contact R H Wallis, 22 Mallard Crescent, Bognor Regis, West Sussex. Telephone (02432) 66795.

Cardiff ZX Group

THE ZX CLUB meets on the last Sunday afternoon of every month at the Central Hotel in Cardiff. It offers a range of software and hardware support for Sinclair users in and around Cardiff. Further information from Mike Hayes, 54 Oakleigh Place, Grangetown, Cardiff. Telephone (0222) 371732.

Streetly Computer Club

A NEW CLUB has formed in Sutton Coldfield. The Streetly Computer Club meets every second Sunday at the Streetly Community Centre, Foley Road East, Streetly. More information about this and about a planned Midlands Sharp Users' Club from Paul Fitzmaurice, 86 Bankside Crescent, Streetly, Sutton Coldfield, West Midlands B47 2JA.

Crawley Computer Club

CRAWLEY ZX USERS' CLUB meets every Monday in the Lady Margaret School in Ifield. On June 12 they mounted a successful exhibition in conjunction with the Crawley Computer Club. Subscriptions are £3 per year, and membership is growing quickly. For more information contact John Heron, 23 Petworth Court, Bewbush, Crawley, Sussex. RH11 8UJ. Telephone (0293) 518396.

Don't let its size fool you.

If anything NewBrain is like the Tardis.

It may look small on the outside, but inside there's an awful lot going on.

It's got the kind of features you'd expect from one of the really big business micros, but at a price of under £200 excluding VAT it won't give you any sleepless nights.

However, let the facts speak for themselves.

You get what you don't pay for.

NewBrain comes with 24K ROM and 32K RAM, most competitors expect you to make do with 16K RAM.

What's more you can expand all the way up to 2 Mbytes, a figure that wouldn't look out of place on a machine costing ten times as much.

We've also given you the choice of 256, 320, 512 and 640 x 250 screen resolution, whereas most only offer a maximum of 256 x 192.

Big enough for your business.

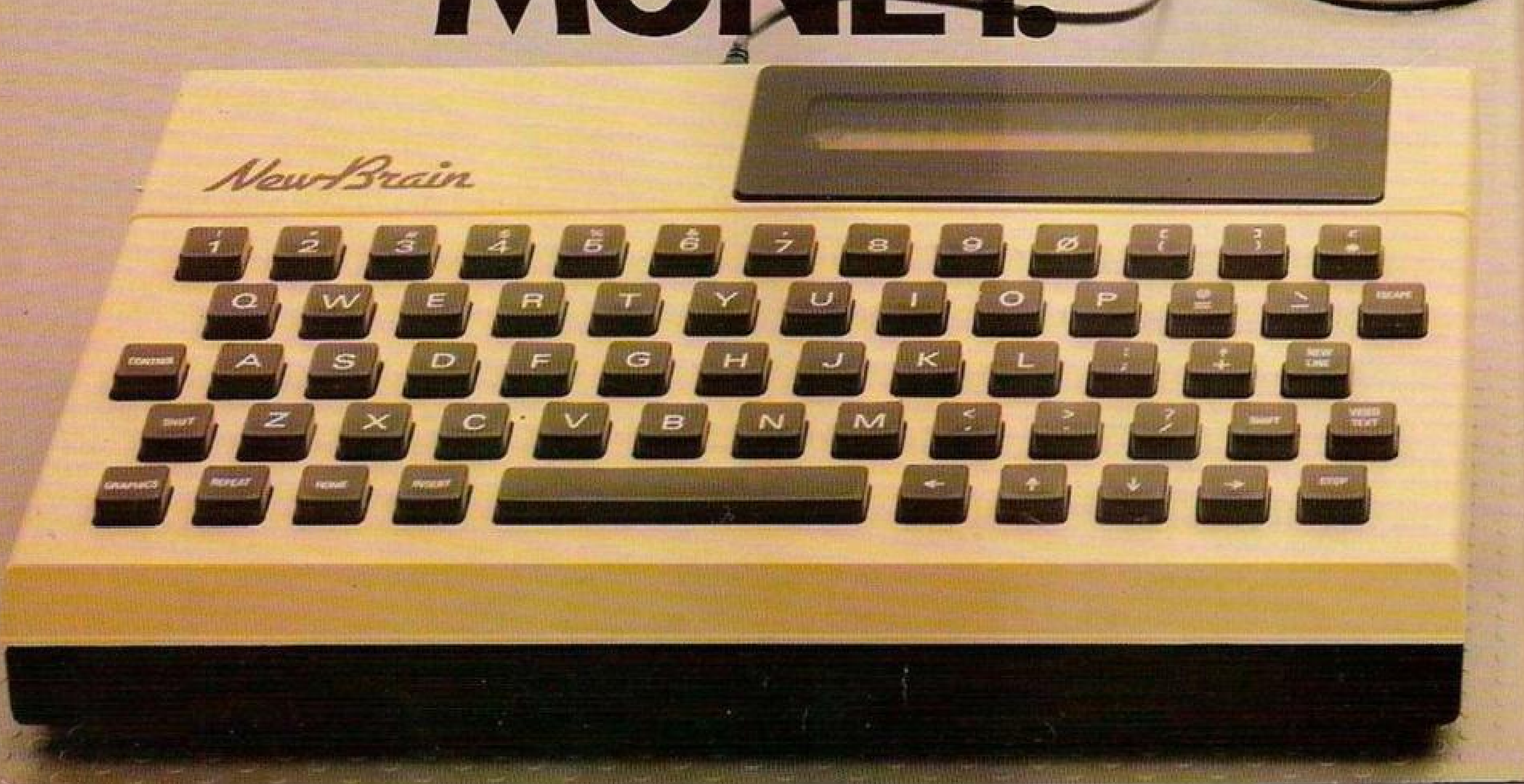
Although NewBrain is as easy as ABC to use (and child's-play to learn to use) this doesn't mean it's a toy.

Far from it.

It comes with ENHANCED ANSI BASIC, which should give you plenty to get your teeth into.

And it'll also take CP/M® so it speaks the same language as all the big business micros, and feels perfectly at home with their software.

NO OTHER MICRO HAS THIS MUCH POWER IN THIS MUCH SIZE FOR THIS MUCH MONEY.



So as a business machine it really comes into its own.

The video allows 40 or 80 characters per line with 25 or 30 lines per page, giving a very professional 2000 or 2400 characters display in all on TV and/or monitor. And the keyboard is full-sized so even if you're all fingers and thumbs you'll still be able to get to grips with NewBrain's excellent editing capabilities.

When it comes to business graphics, things couldn't be easier. With software capabilities that can handle graphs, charts and computer drawings you'll soon be up to things that used to be strictly for the big league.

Answers a growing need.

Although NewBrain, with its optional onboard display, is a truly portable micro, that doesn't stop it becoming the basis of a very powerful system.

The Store Expansion Modules come in packages containing 64K, 128K, 256K or 512K of RAM. So, hook up four of the 512K modules to your machine and you've got 2 Mbytes to play with. Another feature that'll come as a surprise are the two onboard V24 interfaces.

With the aid of the multiple V24 module this allows you to run up to 32 machines at once, all on the same peripherals, saving you a fortune on extras.

The range of peripherals on offer include dot matrix and daisy wheel printers, 9," 12" and 24" monitors plus 5¼" floppy disk drives (100 Kbytes and 1 Mbyte) and 5¼" Winchester drive (6-18 Mbytes).

As we said, this isn't a toy.

It doesn't stop here.

Here are a couple of extras that deserve a special mention.

The first, the Battery Module, means you won't be tied to a 13 amp socket. And, even more importantly, it means you don't have to worry about mains fluctuations wreaking havoc with your programs.

The ROM buffer module gives you a freedom of another sort.

Freedom to expand in a big way. It gives you additional ROM slots, for system software upgrades such as the Z80 Assembler and COMAL, 2 additional V24 ports, analogue ports and parallel ports.

From now on the sky's the limit.

Software that's hard to beat.

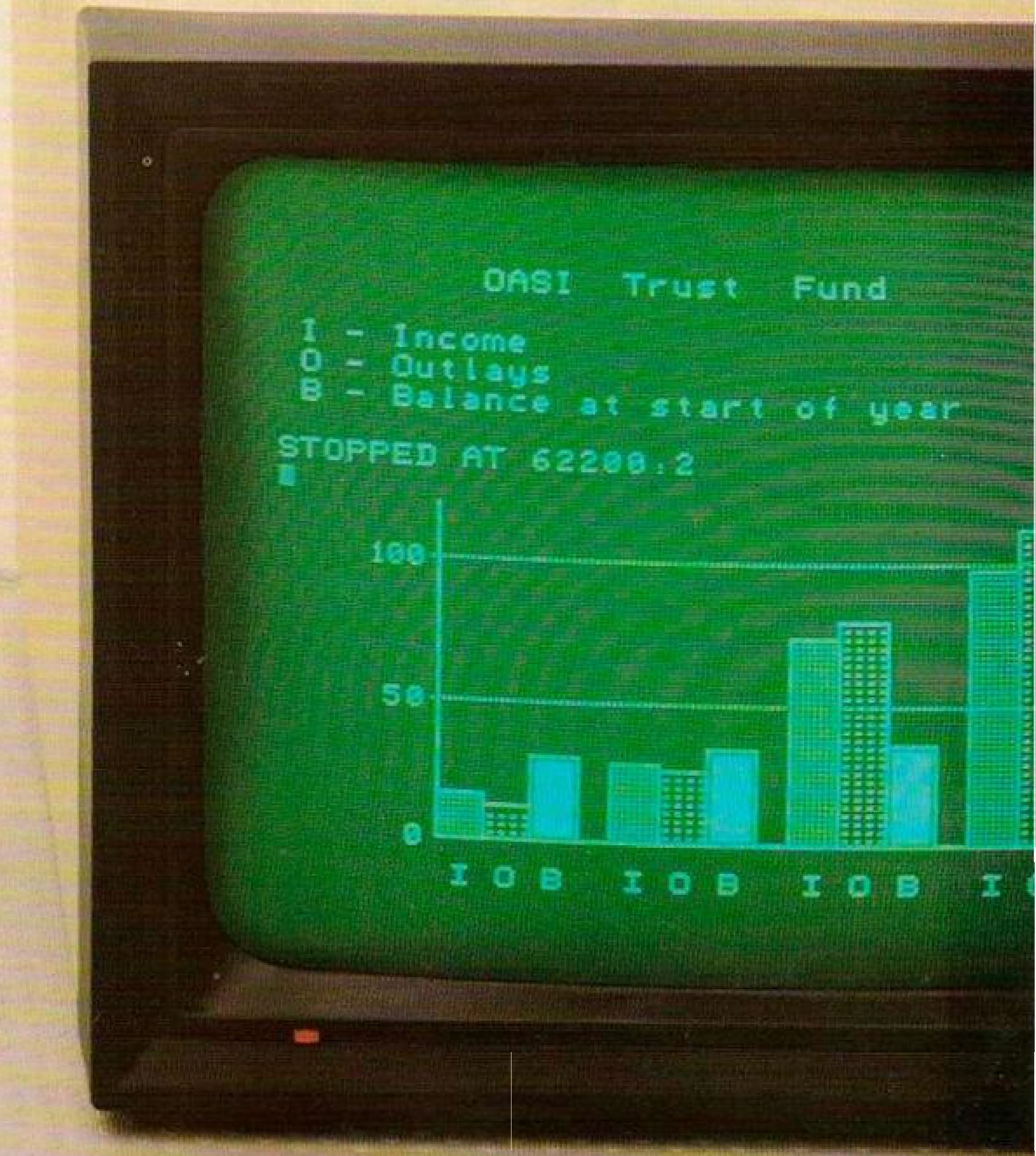
A lot of features you'd expect to find on software are actually built into NewBrain so you don't need to worry about screen editing, maths, BASIC and graphics.

However, if you're feeling practical you can always tackle household management, statistics and educational packages. And because NewBrain isn't all work and no play, there's the usual range of mind-bending games to while away spare time.

Waste no more time.

To get hold of NewBrain you need go no further than the coupon at the bottom of the page.

With your order we'll include a hefty instruction manual so you'll know where to start, and a list of peripherals, expansion modules, and software so you'll know where to go next.



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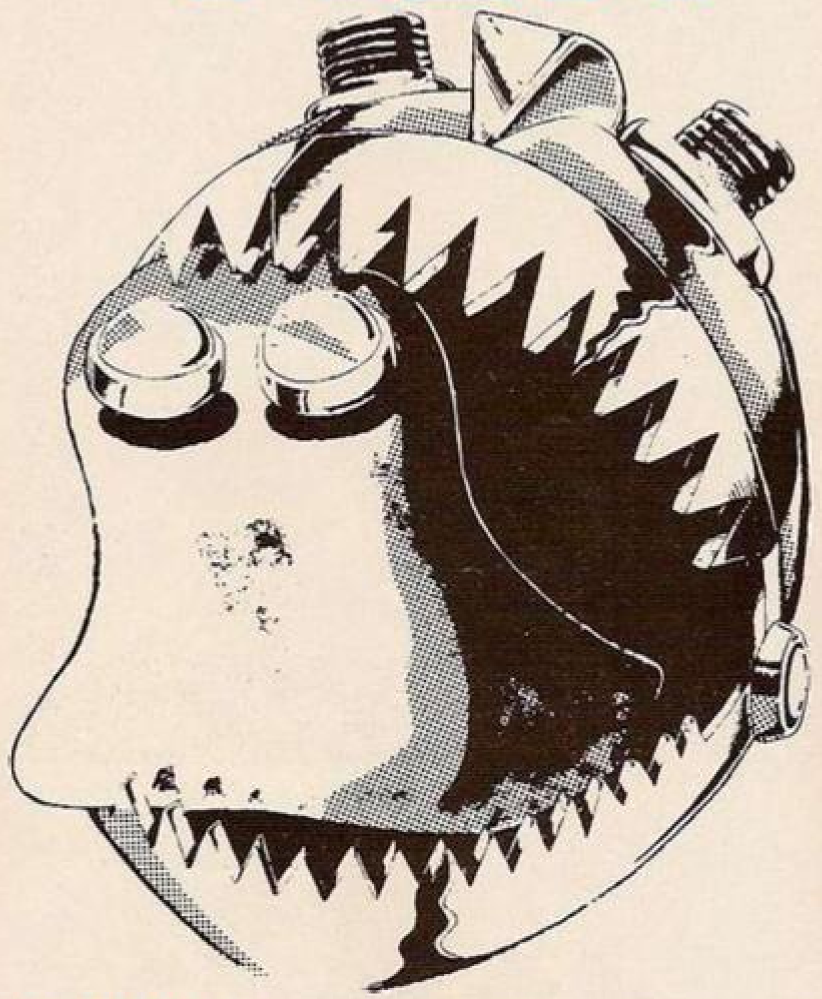
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'VIC-MEN' is available from Bug-Byte direct, or from most good computer shops for only **£7.00** including p. & p.

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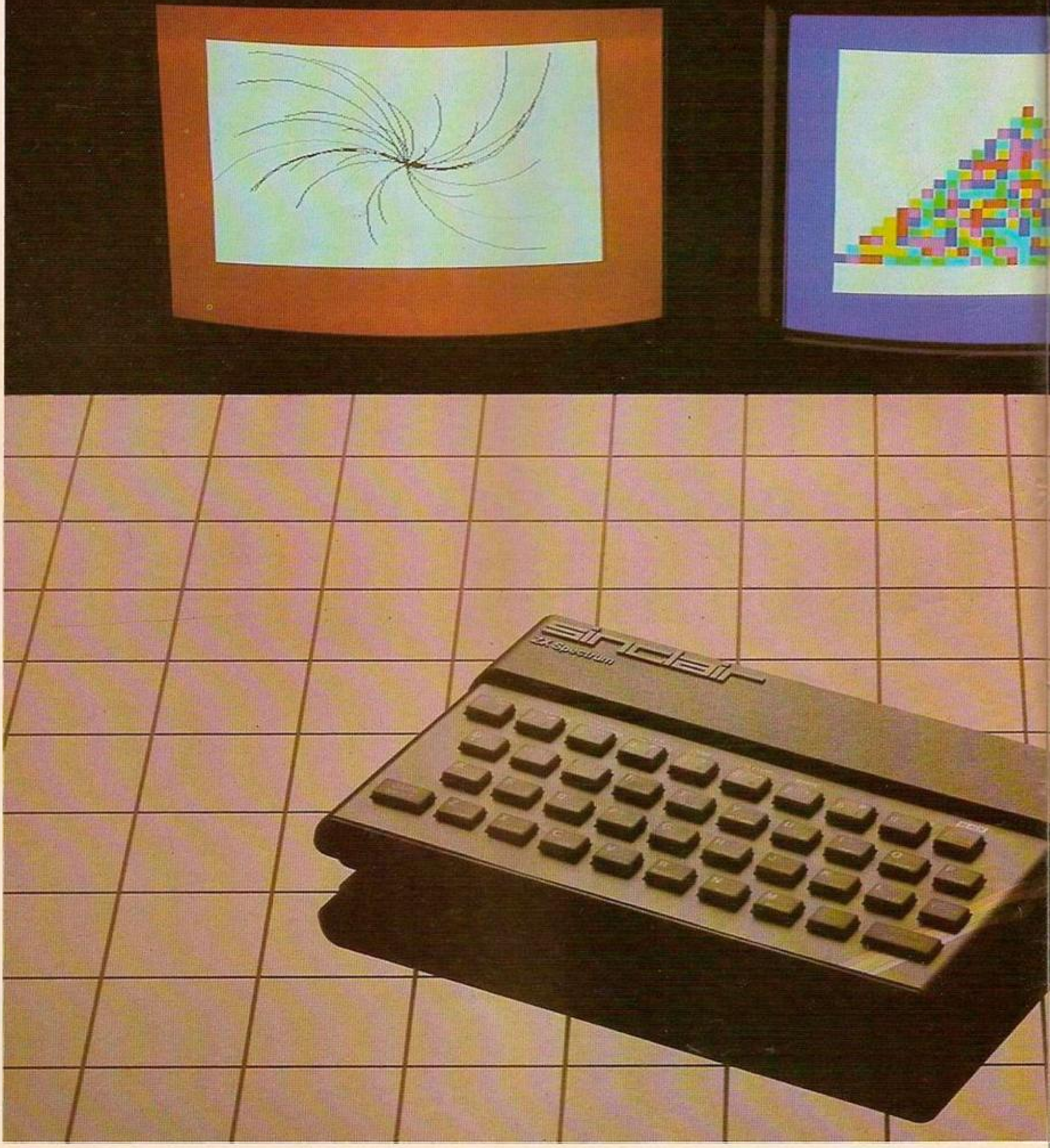
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GRAPHICS
SPECTRUM HUE AND





The rumpus caused by the Spectrum's graphics and sound follows hot on the heels of the micro's release. Even those usually blind to the charms of Sinclair machines could well succumb to the attractions of these low-cost facilities. Reviewer Tim Hartnell shares the fruits of his graphics session at the Spectrum keyboard.

THE NEW ZX SPECTRUM is equipped with powerful graphics commands which can greatly enhance your programs. They are simple to use, and capable of producing a wide range of effects.

The colour command controls the border around the main display area — accessed by the command Border — the main display area itself — known as the Paper — and the colour in which printing is carried out — the Ink.

Eight colours are available if you include black and white, and these are numbered from 0 to 7. The colours, and their corresponding numbers, are:

0 black
1 blue
2 red
3 purple or magenta
4 green
5 pale blue, or cyan
6 yellow
7 white

On a black and white television this order represents a transition of tones of grey, from black 0, through to white 7.

When you first turn the Spectrum on, you will have white Paper, a white Border and

```
10 REM program one
20 FOR b=0 TO 7
30 FOR p=0 TO 7
40 FOR i=0 TO 7
45 BORDER b: PAPER p: INK i
46 CLS
50 PRINT AT 10,2;"Border: ";b;"
  Paper: ";p;"  Ink: ";i
60 FOR j=1 TO 20: NEXT j
70 NEXT i
80 NEXT p
90 NEXT b
```

black Ink. That is, the screen is completely white, and any program you enter appears in black. Ink and Paper can be used globally. If a line in the program says Paper 6, followed by CLS, clear screen, the entire background within the border will turn yellow. Similarly, the program line Ink 2 will ensure that all printing from that point on appears in red.

The colours can also be used "locally". If you enter

PRINT INK 1;PAPER 7;"HI THERE"

the Spectrum will print the words "Hi there" in white in a little blue strip. The same local control is possible within Input statements. If you want a string input, you could enter

INPUT (INK 2;PAPER 6;"What is your name");a$

and the question would be printed in red on a little yellow strip.

Entering program 1 will allow you to try out

```
 5 REM Random music
10 BEEP RND/RND/3,RND*60-35
12 BORDER RND*7
15 BEEP RND/RND/2,RND*60-45
20 BORDER RND*7
25 BEEP RND/RND/3,RND*130-65
30 PAPER RND*7
40 CLS
45 BEEP RND/RND/2,RND*40-5
50 GO TO 10
```

the colour commands. This goes through all the combinations of Border, Paper and Ink. It takes quite a long time to run because there are 512 (8^3) possible combinations, although several are not very interesting. White ink on white paper with a white border is not particularly easy to read.

The clear-screen line, 46 CLS, makes the paper colour global. With it, the paper only changes underneath the words being printed — try the program without line 46. Ink commands used within a program are automatically local if coupled directly with a Print

```
10 REM Program three
15 PAPER 5
17 CLS
20 FOR g=1 TO 100
30 INK RND*7
40 PAPER RND*7
50 BORDER RND*7
70 PRINT AT RND*21,RND*9;"This
 is a demonstration"
80 NEXT g
```

or Input statement. A global Ink command such as Ink 2 for red printing is not changed by a local Ink command such as

PRINT INK 1;"test"

as the ink colour reverts to the one which was globally defined as soon as a Print statement without an ink parameter appears in the program.

Program 2 shows how effectively the colours can mix when they are chosen randomly. The program draws a pyramid of little coloured blocks. The border flashes alarmingly all through the program, and finally, line 155, turns blue. Line 160, which just calls itself, is designed to suppress the OK report code which would otherwise spoil the display. Break to escape.

The little black square at the end of line 100 is available directly from the keyboard in the

```
 10 REM Galaxy
 20 PAPER 0: BORDER 0: CLS
 30 LET c=255: LET d=175
 40 INK RND*7
 50 LET a=c*RND
 60 LET b=d*RND
 70 PLOT a,b: PLOT a,d-b
 80 PLOT c-a,b: PLOT c-a,d-b
 90 IF RND>.5 THEN GO TO 60
 95 INK RND*7
100 GO TO 50
```

graphics mode, white shift key, then press key 9, and then pressing the 8 key, still holding down the white shift key. Inverses of other characters are available by simply pressing the Inv video, white shift key, then the 4 key. You revert to what is called True video, by pressing the white shift key, and the 3 key. The black background behind inverse letters turns into the Ink colour, and the letters themselves turn into the paper colour, which can look most effective, as program 3 indicates.

The Plot commands allow very high-resolu-

(continued on next page)

```
 10 REM Solid Sine
 20 REM © Colin Hughes,
        Hartnell    1982
 30 BORDER 2: CLS
 40 FOR x=0 TO 63 STEP .5
 50 LET y=20*SIN (x/32*PI)
 60 IF y=0 THEN GO TO 100
 70 FOR n=0 TO y STEP SGN y/4
 80 PLOT INK RND*6;x*3+30,3*(n+
30)
 90 NEXT n
100 BEEP .1,x: NEXT x
```

```
 10 REM Tunnel vision
 15 BORDER 5: PAPER 7: CLS
 20 CIRCLE INK RND*6;128+RND*10
-RND*10,86+RND*7-RND-7,RND*65
 30 IF RND>.92 THEN CLS
 40 BEEP RND/3,RND*100-30
 50 GO TO 20
```



(continued from previous page)

tion graphics, as can be seen by running the Galaxy and Solid Sine programs. Solid Sine is the basis of the program used on the front cover of this issue of *Your Computer*. You will notice that while the dot resolution is 256 by 192, the colour resolution is only 32 by 22. In effect, the colour is mapped on to the Plotted screen.

Despite this, high-resolution designs can still be created. You can prove this by entering and running the next program, Broken Glass, which uses the Draw command. The paper is set to white in line 30, then the border, line 50, and the ink colours, line 60, are chosen at random. Line 70 checks these are different — and if not chooses a new ink colour.

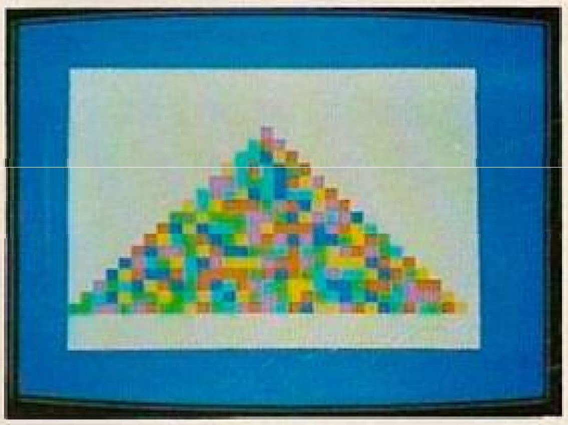
The screen is cleared in line 100 and a pair of co-ordinates are chosen randomly. A point is plotted in the centre of the screen, line 130, and a line is drawn from this point to the previously chosen co-ordinates. The Draw statement works out how long the line has to be, and at what angle, but Plot must give it a starting point.

The Draw command draws lines when the word Draw is followed by two numbers. These numbers are the Plot co-ordinate of the finishing point of the line. If you add a third number, the Draw command will draw part of a circle, with the third number specifying an angle to be turned through. Broken curves is the same as Broken Glass except for the end of line 140. This draws a wind-swept version of Broken Glass, by turning the line through PI/2 radians as it is plotted.

The Circle command draws quite good circles. Tunnel Vision sets a pale blue background, and white paper, then draws a series of circles in a random colour, around a centre point which changes a little from circle to circle, with a random radius. The first number after the word Circle is the x co-ordinate of the centre, the second is the y co-ordinate, and the third is the radius.

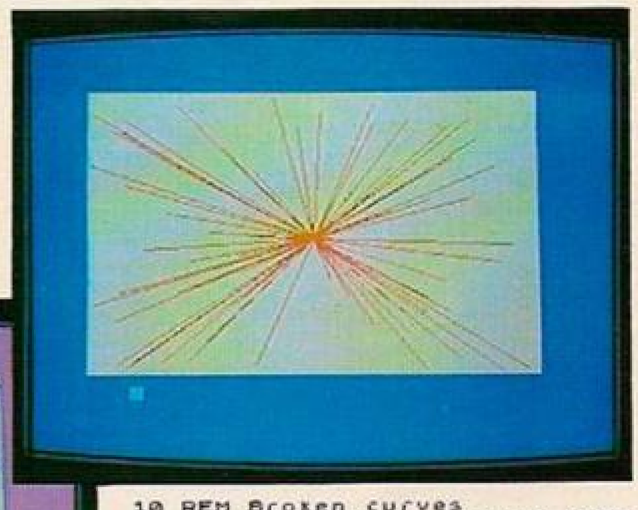
If you want to combine colour and sound, enter and run the Random Music program. Access Beep by pressing both shift keys, then holding down the red shift while pressing the Z/Copy key. The first number after the word Beep controls the duration of the note in seconds, while the second number is the pitch. The Spectrum has a range of around 130 semitones, with middle-C at 0, C-sharp at 1, and -1 is the B below middle-C.

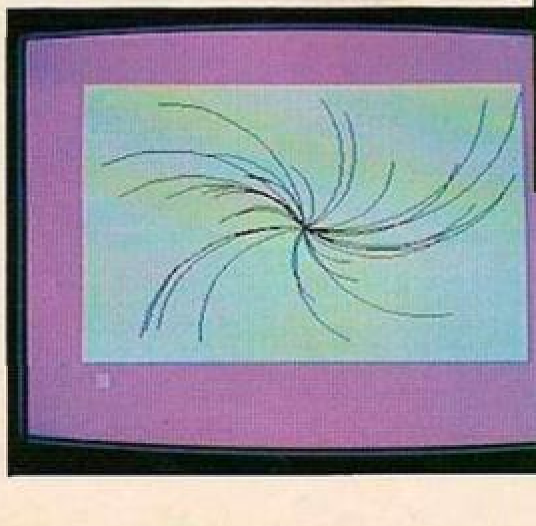
This is just an introduction to some of the graphics commands on the ZX Spectrum. Experiment with them, enter and modify the sample programs given, and you are sure to find many ways of enhancing your own programs. ■



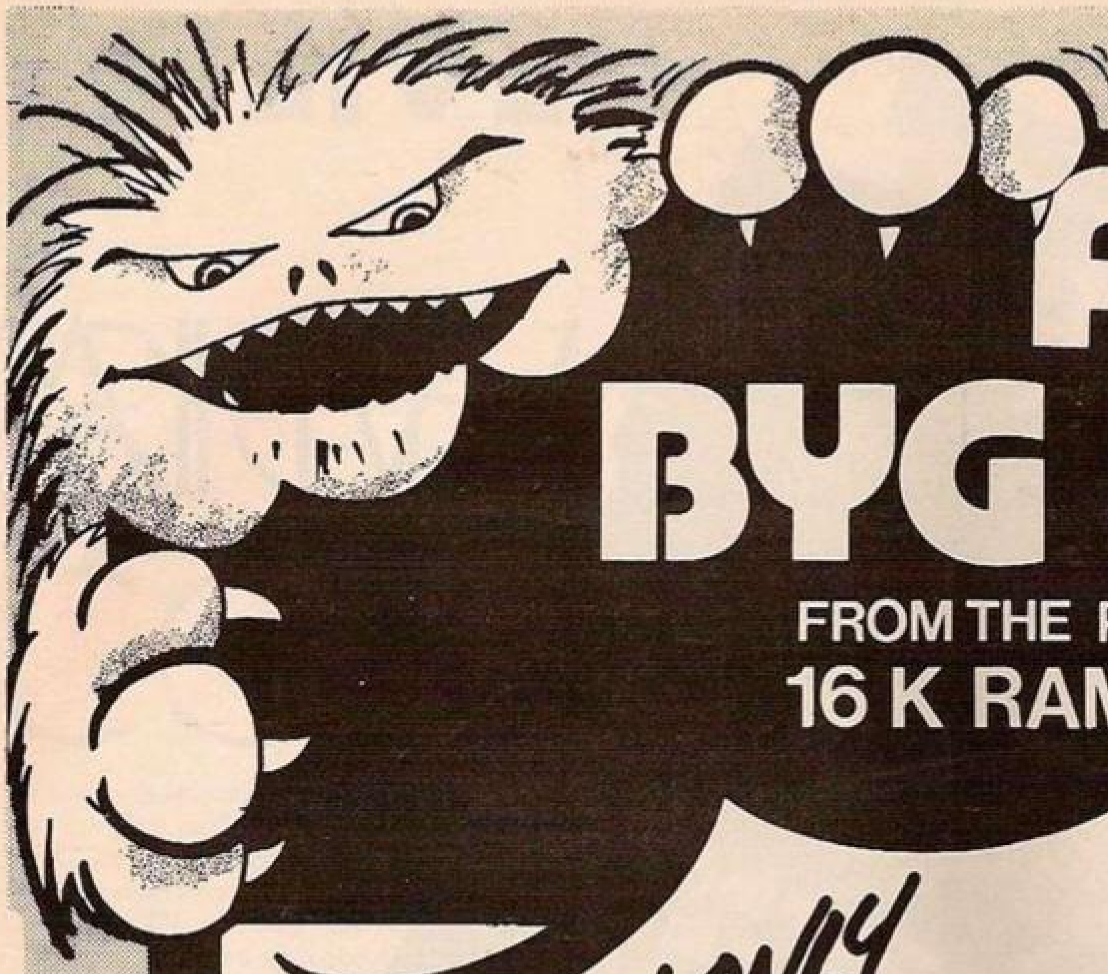
```
  5 REM Program two
  6 REM Pyramid
  7 REM © Hughes, Hartnell
 10 BORDER 7
 15 CLS
 20 LET b=16
 50 LET t=0
 60 LET s=0
 70 LET l=20
 80 LET t=t+b
 90 FOR n=s TO s+b*2-2
100 PRINT AT l,n; INK INT (RND*
6)+1;"█"
105 BORDER INT (RND*6)+1
110 NEXT n
120 LET l=l-1
130 LET b=b-1
140 LET s=s+1
150 IF b>0 THEN GO TO 80
155 BORDER 1
160 GO TO 160
```

```
 10 REM Broken glass
 20 REM © Hartnell, Ruston 1982
 30 PAPER 7
 50 LET a=INT (RND*8)
 60 LET b=INT (RND*7)
 70 IF a=b THEN GO TO 60
 80 BORDER a
 90 INK b
100 CLS
110 LET c=INT (RND*256)-128
120 LET d=INT (RND*172)-85
130 PLOT 128,86
140 DRAW c,d
145 BEEP .01,RND*100-50
150 IF RND>0.02 THEN GO TO 110
160 RUN
```





```
 10 REM Broken curves
 20 REM © Hartnell, Ruston 1982
 30 PAPER 7
 50 LET a=INT (RND*8)
 60 LET b=INT (RND*7)
 70 IF a=b THEN GO TO 60
 80 BORDER a
 90 INK b
100 CLS
110 LET c=INT (RND*256)-128
120 LET d=INT (RND*172)-85
130 PLOT 128,86
140 DRAW c,d,PI/2
145 BEEP .01,RND*100-50
150 IF RND>0.02 THEN GO TO 110
160 RUN
```



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WHAT



Do you yearn to step through that dreary monochrome screen into the wonderful world of Technicolor? Well, if you already own a ZX-81, Haven's 16-colour board promises to put you somewhere over the rainbow for a fraction of the cost of a Spectrum. Tim Langdell finds out whether Haven can produce acceptable colour for £50 and also checks out its £25 ZX-81 character generator.

ONE MAJOR FEATURE which the Spectrum offers but the ZX-81 lacks is colour. The Haven colour board might offer a way for ZX-81 owners to upgrade to colour machines without having to buy a new micro. But how well does it perform? And is it worth the £45 or so that it costs?

The specifications sounded promising. 16 different colours — each character space on the screen can be any one of these colours, and all 16 can be displayed at the same time.

Simple connection

The board is uncased and attaches to the ZX-81 via the usual 23-way edge connector, as do so many other add-ons. It lays flat at the back of the Sinclair so there are no problems of excess mechanical stress on the edge connector which might lead to faulty electrical connection during programming. Our board had a foam base under it which kept movement of the board to a minimum.

One simple connection needs to be soldered to the ZX-81 circuit board. The television lead must be plugged into the socket on the colour board and not into the ZX-81 as usual. This means that without a switch, which Haven does not supply, you cannot move from colour to black and white.

On switching on, the screen went fuzzy orange and no cursor could be seen. Haven claims that for the first 20 seconds the colour board's display file is being cleared and as time passes the screen settles down and the cursor becomes readable. In our case the picture was of very poor quality even after some minutes of use.

As Haven notes in the instructions, the background colour can be varied to green by use of a switch on the board. Using this switch gave a green background to the picture, but if anything the text was even harder to read. Waves of a darker colour advance down the screen and ripple the whole display. Haven claims this can be cured by putting extra smoothing capacitors across the power supply. However, no instructions on how this could be done are included.

Haven's short display program produced poor quality colour, varying only between dark-green and light-green to purple and blue, and as the program proceeded and more of the screen was filled the picture began to break up. Picture break-up occurred whenever a program was run.

Haven claims that this problem is unusual, and that the board performs differently with different televisions. This was confirmed by testing the board supplied with a Bush 14in., a Sony Trinitron, and a Ferguson 24in. Colourstar. The poor-quality picture mentioned earlier was obtained with the Bush, but no colour picture at all could be obtained with either the Ferguson or the Sony. Clearly anyone interested in this board should check with Haven first whether it will work with their TV.

Blues and greens

No instructions for adjusting the board were supplied. On request, Haven sent details of how to vary four potentiometers, but this made little difference to the display.

Although printing the 16 colours, coded 1 to 16, with the board supplied resulted in variations on green and blue, the performance of the Haven board at recent shows seemed to show it should be capable of a range of at least eight colours. Our board seemed to lack the ability to produce red, or even colours including red.

At best the board may be capable of blue, red, green, orange, purple, pink, black and pale yellow for white.

The colours are set by Poking a command of the form

```
POKE A+ X + 33*Y,C
```

where A is the position in memory of the first screen position in the colour file, and is about 15,000 bytes further up than the Sinclair display file. X and Y are the co-ordinates of the character square, so X=0,Y=0 is the top left position. C is the code, 1 to 16, of the colour you want the character square to appear in.

PRICE COLOUR?

CHARACTER GENERATION

```
 10 FOR A = 7680 TO 7860
 20 POKE A,0
 30 NEXT A
 40 FOR J = 128 TO 148
 50 PRINT CHR$ J
 60 NEXT J
 70 LET T=1
 80 FOR X = 1 TO 4
 90 FOR K = 7680 TO 7860 STEP T
100 POKE J -4, 0
110 POKE J, 16
120 NEXT J
130 LET T = T -.2
140 NEXT X
```

This program Pokes a line down the centre of a character and then rubs out the top of the line and adds a dot at the top of the next character. This process is repeated until the line is down the centre of the next character, and then the next, and so on. Thus by Poking all the characters with 0 first and printing them down the screen the appearance of a line flowing smoothly down the screen can be achieved. The X-loop in the program runs the display four times, each time the line moves down more slowly. The memory locations in lines 10 and 90 vary from one generator to another. Not very useful as it stands, but the idea can be the basis of smooth graphics without recourse to machine code.

In theory it is quite possible to have all 16 colours present on the screen at the same time. The Spectrum, by contrast, can only manage eight. However, you will recall that, depending on your TV, you may only be able to get eight distinct colours with the Haven board anyway. The variation with different TVs from rather poor quality to acceptable colour is disappointing but hopefully Haven can soon bring out a version which works equally well on all sets.

Memory-mapped

The colour board is memory-mapped, and uses an area of memory from about 32000 to 32768. This is in the form of a colour file, as Haven calls it, which sits at the top end of the memory area used by a 16K RAM pack, but is stored in an on-board RAM. The colour of each character position on the screen is Poked into this area prior to printing at that position.

The colour file moves around in memory and its position is relative to the display file. Thus the memory location into which the colour of the first screen position should be Poked is calculated by

(PEEK 16396 + 256*PEEK16397) + 15427

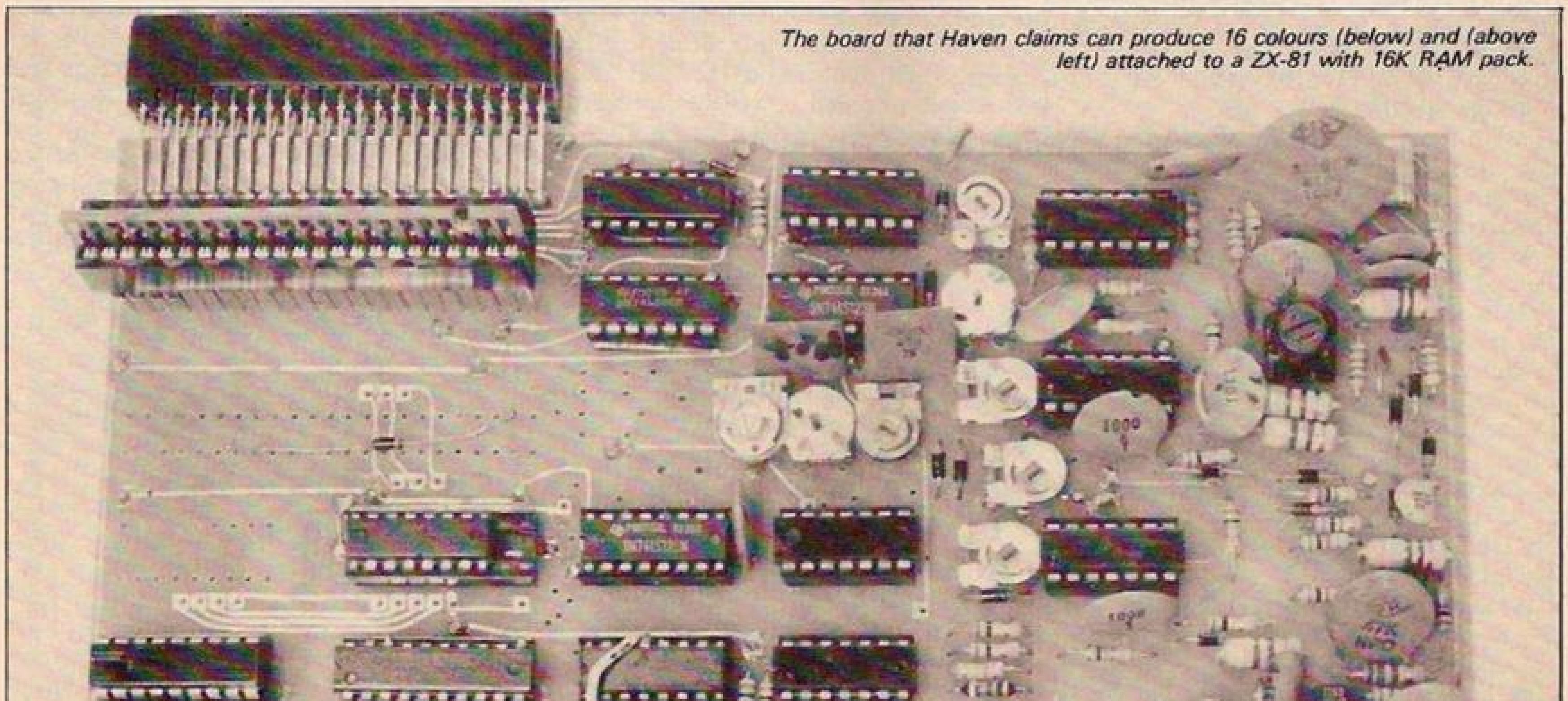
This file thus sits about 15K above the display file and moves around as it does. You must be careful, then, not to overwrite this area of memory.

The board should not interfere with any add-ons and there are two edge connectors on the board making it a mini-motherboard, too. Any add-ons could be plugged on to the supplied 23-way strip which then slots into one of the on-board edge connectors. One problem, though, is that the connectors on the board are vertical and thus the usual 16K RAM pack would lie horizontal in mid-air and possibly be prone to movement as the ZX-81 is used. This is thus another aspect Haven might consider improving along with the ease of setting up the board.

Certain reservations

As the Haven board stands, it seems difficult to recommend it without reservations. If you are interested, check that it will work with your TV. You will also have to consider the resale value of your ZX-81 and weigh the cost of a Spectrum against this. You should also remember that your ZX-81 software will not work with a Spectrum, neither will some ZX-81 add-ons. The Haven colour board costs about £45 and a basic Spectrum about £125. Clearly the cost of a new ZX-81 and 16K RAM together with the Haven board, about about £140, will not be worth considering against a Spectrum. If you already own a

(continued on next page)



The board that Haven claims can produce 16 colours (below) and (above left) attached to a ZX-81 with 16K RAM pack.

(continued from previous page)

ZX-81 and think that all you want is colour, then the Haven board might be the answer.

The Spectrum offers colour graphics in higher resolution, a wider choice of background and foreground colouring, the ability to flash areas of the screen or highlight them, and it can provide inverse video or draw borders at a single command.

Haven has been first in the field to bring out several hardware add-ons to the ZX-81, but the company needs to iron out the bugs in this particular board. Haven's character generator for instance was the first on the market.

Character generators

Have more recent boards superseded it? There are only three character generators on the market, and the other two are by dK'tronics and Quicksilva. All three boards offer different abilities.

Whereas dK'tronics' and Quicksilva's boards require at least a line of Basic to enable them, the Haven board is set up by hardware. On switching on you immediately have a random series of dots in place of your inverse character set. This means that if you do not want a new character set you will have to run a five-line program supplied in writing by Haven to Poke the usual inverse characters into the character board's RAM. This takes about 15 to 20 seconds to run. The user-defined characters are Poked into the board's RAM as a series of eight Pokes per character. Each character on the ZX-81 is made up of eight rows of eight dots, and each row is represented in memory by a number between 0 and 255.

The rows can be thought of as a series of noughts and ones, spaces and black dots, which are represented by a binary number. The first column is 128, and the right-most is the unit column. If the first row of a character is 00110011 then this is represented by

$(0 \times 128) + (0 \times 64) + (1 \times 32) + (1 \times 16) + (0 \times 8) + (0 \times 4) + (1 \times 2) + (1 \times 1) = 51$

Haven's board offers two sets of 64 new characters. The first character set is effectively not memory-mapped, and differs from all other character boards in this regard.

Haven has overlapped this set on top of the Sinclair graphics in the upper 256 Bytes of the ROM. There are only 64 characters in the Sinclair ROM, and the inverse characters are produced at the moment of display by the hardware in the ZX-81. All the inverse characters have a character code exactly 128 higher than the normal characters. Thus when an inverse character is required the data line 7 goes high for just long enough to allow the Sinclair Computer Logic Chip (ULA — Uncommitted Logical Array) to detect it and invert the video for that character.

Haven detects this data line going to a logical high and uses this signal to turn off the ROM and switch on the board's RAM. The unwitting ULA therefore reads the characters from Haven's board at the same memory address. The second character set which you can define with the Haven board is exactly 8K higher in memory, from 15872 to 16383.

This set is activated by Poking to it. Thus the moment you Poke any number to this area of memory the inverse characters are replaced by those derived from these memory locations — once again in consecutive groups of eight bytes. Loading the character set is thus just a matter of Poking to this area, and Poking 0,0 will return you to the lower character set. To avoid changing this second set when calling it you would need to Poke a location within the Peek of the same location.

There is a problem with this second set, though. Almost any command following a Poke to this area of memory sets the characters back to the first one. It is thus very difficult to remain with the inverse characters replaced by this set. Haven recommends this upper set for fast-motion graphics where the movement is obtained by Poking a slightly different character into the equivalent location in the upper set and then Poking this set at the required time to cause a very rapid change between characters. All the characters will change when you do this.

If you have more than 16K of RAM the character board will behave as if only the lower of the two sets exists. Depending upon your RAM's address-decoding you may also find that the area between 8K and 16K is disrupted, or at least that the 15872 to 16383 area is unusable. Problems may also occur with the mirror image of this area in the upper 32K of memory, but this was not the case with the Memotech we tested, or a 64K board available from Buffer Micro.

The board is attached to the ZX-81 via a 40-way ribbon-cable and five wires which must be soldered directly to the ZX-81's circuit board. A soldering iron is essential for these last five wires. Both the ribbon cable and the wires need to come out of the side of the ZX-81's case, and to bring them out on the right-hand side as Haven suggests led to the ribbon cable being too close to the heat sink for comfort. The cable has to be bent and with similar contortions it can be brought out of the opposite side too.

This leaves the board in mid-air and probably upside down. It works well, but looks clumsy. Perhaps Haven could reduce the size a little to fit inside, like d'Ktronics' device.

When the ZX-81 is switched on, an LED lights up to show that you are in the first character set. Poking to the second set causes the second LED to come on as well. This is a useful reminder, but not essential.

Haven supplies three programs with the board: a high-resolution graph plotter, a double-size inverse character routine, and a five-line routine to put the normal inverted characters into the board. The double-size character routine uses the idea of Poking the first four lines of a character into eight lines of a character further up in memory, code 130. Each line of the original character is repeated twice in this higher one. The other half of the character is Poked into the eight lines of the character adjacent to the one last Poked to, code 131.

By similar methods a phrase could be written to double the width of characters instead. This is possible with all character generators that allow user-definition.

Plotter program

The high-resolution plotter program would not work. Haven is debugging this routine though, and hopes to provide new orders with an error-free version. If you have already purchased a Haven board then these corrected programs can be obtained from them. Another new program is a smooth graphics routine. By printing a series of blank characters Poked with 0 or 255 down the screen you can then Poke to adjacent memory locations to obtain the effect of a shape moving rather more smoothly down the screen than is obtained by Print At or Plot/UnPlot. This is also possible with other boards offering user-definable graphics.

This is a useful board, but the instant new set of graphics every time you switch on are a mixed blessing. Unlike Quicksilva, this board will not allow 128 different user-defined characters on the screen at once. On the plus side, the Haven board does not require a software routine to print characters on the printer. The problems of using the second set of characters could be a nuisance, as could the physical positioning of the board. As well as considering reducing the size of it to fit inside the ZX-81, or making it easier to lie flat alongside the ZX-81, Haven might consider adding a switch to enable you to choose whether you want new graphics when you switch on, or the usual Sinclair inverse characters.

CONCLUSIONS: COLOUR BOARD

- Most of the circuits on the board were blacked over which made it difficult to check the circuit.
- 1K of RAM on-board is used for a colour file which holds information about the colour of each character position on the screen in the form of numbers between 1 and 16.
- This display file sits at about 15K, but is parallel to the Sinclair's display file and moves around in memory as it does.
- Find the memory address which holds the code for the colour of the first position by calculating:
  (PEEK 16396 + 256*PEEK 16397) + 15427
- The Sinclair display file's first position on the screen is found by calculating PEEK 16396 + 256* PEEK 16397 + 1, and so the connection between the two files is obvious.
- The colour file uses the same area of memory as the upper area of the 16K RAM pack. This does not affect the functioning of the RAM pack,,but you must be careful not to overwrite this area with Basic programs.

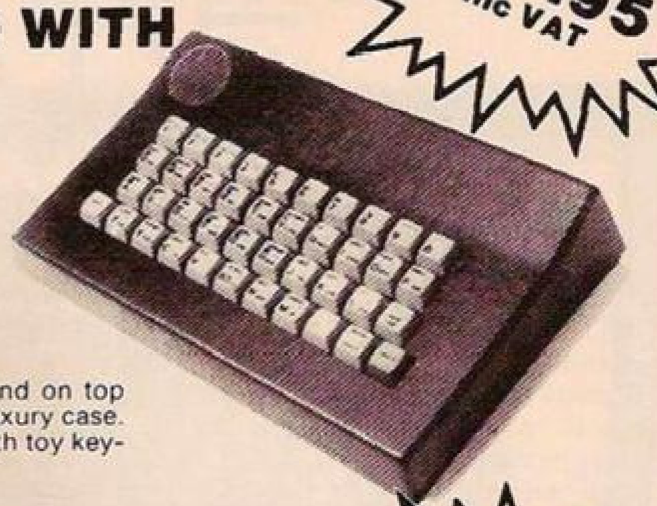
CONCLUSIONS: CHARACTER GENERATOR

- At £25 a character generator can be a useful addition to your ZX-81, and can enhance the screen display of space ships, tanks, or technical figures tremendously.
- The Haven board works well.
- Alternatively Quicksilva offers 128 characters at once with easier fitting and removal when not needed, while dK'tronics board has preprogrammed characters resident on 4K of ROM. ■

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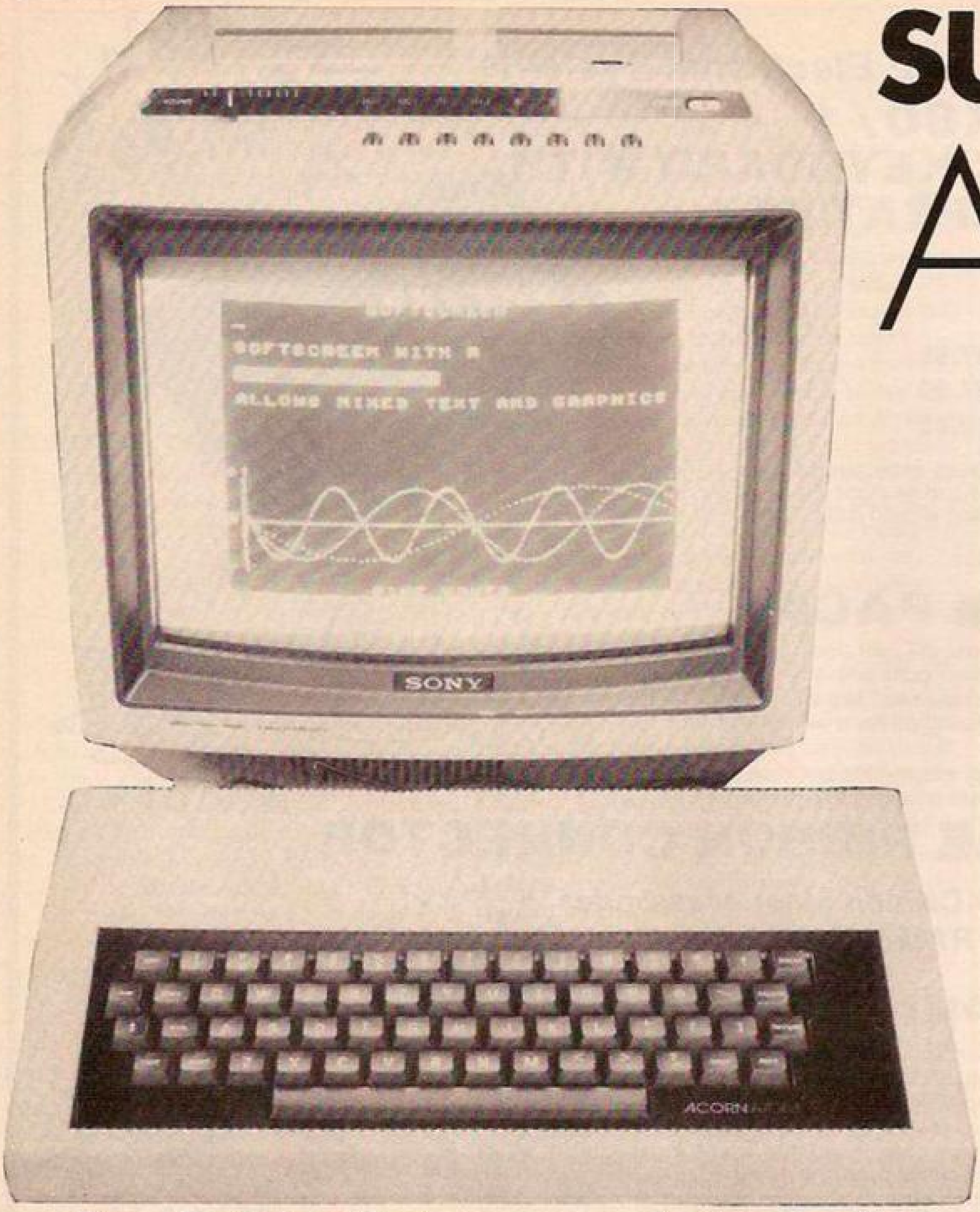
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SURVEY ATOM



Space Conflict and Backgammon sound miles apart, but they are just inches away from each other on Eric Deeson's cassette rack. Here are his views on over 100 new programs for the Acorn Atom.

SINCE OUR LAST survey of Acorn Atom software in *Your Computer*, November 1981 the big software publishers have churned out masses of material, and new companies have entered the scene. The flood of software has not abated with the introduction of the BBC machine and the Atom's BBC upgrade chip.

Though the range has improved there is still a lack of serious software for this micro.

Loading is still a problem. It is a pity that the *Load "Index" system is not a precise indication of correct level for the main material, and anyway some suppliers do not use it. Most readers' letters in response to the first survey agreed that loading was a problem. RMK Electronics of New Milton kindly sent a lead which has helped, and also works for my BBC Micro.

Acorn Atom software is more expensive than that for the ZX-81. Suppliers to a small market must cover their fixed costs with potentially smaller sales, but high software prices probably keep down hardware sales. Acornsoft have not really set a clear lead — they offer superb presentation but at a high price. A few good cheap programs show that it is possible. Suppliers should think of long-term gains rather than short-term profits.

Acornsoft

INTERACTIVE TEACHING is the first cassette in the Acorn Introductory Package, all 3K text; the total cost is £23. This is "designed to introduce you to the Atom computer, and to the Atom Basic", and is a very useful add-on to the manual.

You need to use "Index" to set volume before you start. This should be star-loaded by typing:

*LOAD "INDEX"

Interactive teaching covers keyboard layout, number and text and graphics handling, and the elements of programming. Not bad — but not for the real beginner.

Financial Planning includes a lengthy and impressive form of VisiCalc called Minicalc. This has only 10 lines of five fields each but deserves an extended cassette of its own.

This cassette also includes a program for plotting monthly sales over a yearly period.

Household has programs for storing names and phone numbers, touch-typing training, and providing alarm calls at set intervals. The first book, "T book", builds up your own data file — up to 95 entries no longer than 2 × 16 characters each. The files you build up are saved separately.

Typer and Timer are straightforward effective programs, but I wonder how often one would use the latter instead of a conventional pinger or alarm watch.

Acorn's intention to market the computer seriously is perhaps shown by their placing the games cassette last in this introductory package. The games include an excellent Attack and a superb Breakout with advancing walls, speed change, directional return, and current/highest scores. The cassette also includes mastermind, a form of tic-tac-toe and a nice memory-testing card game.

Recent additions

Recent additions to Acornsoft's range are all neatly ensconsed in polystyrene foam cases with colourful and informative fold-out card covers. A row of these paperback-sized packages looks so good on a shelf that many must be bought for that reason alone. At £11.50 each they are expensive, but usually of high quality and reliability.

Some of these programs must be *Run rather than *Loaded or plain Loaded. If Acorn made the first instruction P.$7 it would beep when loading was finished and save much frustration.

Three new packages have appeared in the Games Pack series. Games 8 comprises Stargate and Gomoku with 5K text and 2K graphics, and Robots — 4K and 6K. Gomoku is a good implementation of the two-player strategy game with simple cursor control and key entry of moves. Both the other games are variations on sci-fi combat themes. Stargate uses invader skills only, and is memorable for its sound effects. Robots is a neat, addictive graphics game which is similar to Tank.

Games 9 presents Snapper, a version of Pac Man which my children and their friends particularly enjoyed. Minotaur is a 5K and 6K adventure-in-a-labyrinth game, with 3D views of the passages before you. Babies is a 5K and 3K horror. If you are somewhat revolted by the violence of Atari's Circus, do not read on. Instead of a paid clown to crash around in the concrete, you must catch babies falling from a skyscraper. What a strange mind the author has.

Games 10 is for the minimum 8 and 2K Atom. It is a pleasure to note that many of the 10 programs here are thoroughly good value in view of the restrictions on memory. Those

SOFTWARE

owners of expanded Atoms have to start with
?18 = 130,
a very difficult step to remember.

The programs on this tape are a good mix of old and new — a Breakout and a variant called Hectic; Mastermind; slalom; snake; road-race; Simon; squash; lander; and something called Bombs away, which is a projectile routine really.

Adventures needs 5K and 6K and uses the fact that all adventure programs are essentially the same. The situations may differ, as may the obstacles, attackers and objects — but the skeleton code remains the same. Acornsoft ask you to load the skeleton, and then to load the fantasy of your choice. Dungeon, Haunted House and Intergalactic are the alternatives.

If I were an adventure fan, I would prefer the more modern graphics variants to these. The Acornsoft adventures are entirely traditional in format and approach.

Acornsoft have also produced one of the best versions of Life. Essentially it is a pattern-generating algorithm with a long history. An initial design is described in terms of cells, living ones originally, equivalent to lighted pixels. These die, survive or reproduce following certain important rules. In most versions for micros, the rules are not accurately followed; in others, generations succeed each other at a frustratingly slow rate. The Atom Life — 5K and 1K to 6K depending on mode chosen — is extremely sophisticated in use, and it is both law-abiding and fast. In the fastest reproduction rate, Model 1, the 128 × 64 cell positions produce over two generations a second.

Any initial design

The controls allow one to draw any initial design including any of the seven stored patterns, such as glider, let generation go at speed, or step through it; and to edit at any stage. The cassette also contains five starting designs you can call on if you wish.

Acornsoft's Chess is impressive for 5K and 6K. It thrashed me even at the lowest of its six levels. The board display is fairly crude but move entry is versatile and straightforward. You can change sides, or the computer can play both sides; you can step back and forth through the moves and try new avenues at will. The 5K and 6K Synthesiser is another impressive bit of software. There is space for four tunes of up to 255 notes each including rests, and there are four voices. These may be played in any sequence, almost indefinitely, producing quite sophisticated melodies. The whole thing is made that much neater by a delightful screen display of the score in musical notation. Additionally there are practice and editing routines.

Serious programmers will welcome Forth — 5K and 1-6K. Forth is more of a system than a high-level language, in which one can define commands and routines effectively as procedures and applications. Forth bears no relation to Basic or machine code. The Atom Forth is up to standard and comes on cassette rather than chip with its own editor, graphics pack and demonstration application. There are plenty of good books on the subject, but the Acorn special at £6 is excellent.

Database addicts will not think much of Desk Diary, which contains Address Book and Planner — each 5K and 6K. Both are trivial and restricted in number of records, up to 100 and 300 respectively, and do not compete with an old-fashioned desk diary.

Acornsoft's Word Tutor — 5K and 6K — is a teaching program. It is good that Acorn's first teaching program is not a two-a-penny mathematical program but unfortunately this software is not up to standard. No English teacher was involved in its preparation. The first program is Pairs which omits letters from words leaving the pupil to select one of two or three presented completions. There is no educational value in that, and the use of poorly punctuated high-flown language is pointless. What is the idea of opening with the question "Do you want to start?" and then accepting only the affirmative?

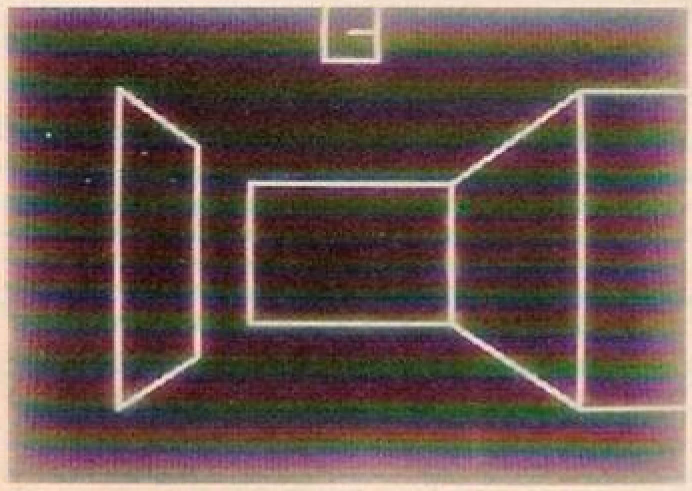
The sophistication of supervisor control, which can even have password entry, is impressive. Teachers can create their own data bases, view the exercises with answers, and even get fairly good records of how well up to 16 users have done. This could have been made much better with a little extra effort.

A & F Software

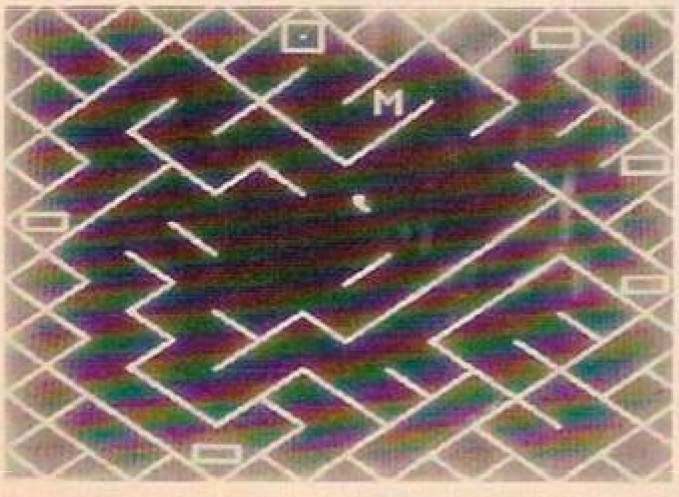
THIS FAIRLY NEW company in Atomland is increasing its range steadily and has its eye firmly on the BBC market too. All the tapes have Atom-style Indexes and cursory instructions.

Cylon Attack — 5K and 6K, £4.95 — is a program which resembles Missile Command. You must move to each attacker and fire to destroy it. Cylons come in three makes, with

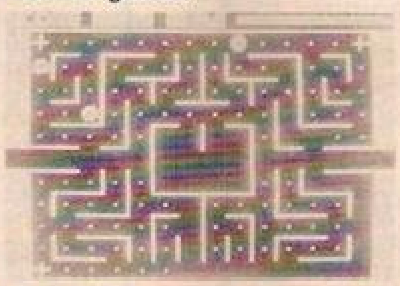
(continued on page 35)



Minotaur presents a three-dimensional view of the maze (above). The square at the top of the picture tells you which way you are facing relative to the map (below).



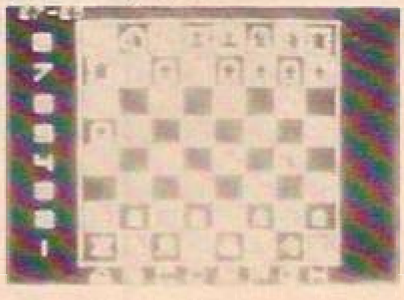
Acornsoft's Snapper is similar to PacMan games.



A & F Cylon Attack resembles Missle Command.



Bug-Byte's Chess needs 12K but offers many levels.



(continued from page 33)
different kill-scores. They can shoot at you and ram you too. Fuel is relevant; current and highest scores are displayed. An excellent screen here, nice sound and a fast-moving game. The instructions are adequate.

Coming right down to earth, Polecat is a 5K and 6K game for £4.95. The rabbit lives in a maze of a warren under a field of carrots. Meanwhile the polecat makes the rabbit's life a misery, whether in the maze or out in the field.

Early Warning — 4K and 6K, £4.95 — is another attempt to destroy invaders. This is even closer to Missile Command with 48 waves of missiles to destroy, level increasing with each wave. Just to make death that little bit easier, the missiles are invisible once they get on to the screen. Score and wave number are displayed. Missile Command is my favourite Atari game; this is not a bad imitation.

"I won I often do" boasts the executioner in Robot Nim — 5K and 0.5K, £2.95. Nim is a straightforward game of binary strategy. Even if you find Nim boring you will be entranced by this gorgeous version. Up to five rows of shaking robots await their fate. The robot executioner marches to and fro, following your instructions or its own. The victims scream when they see it's their turn for annihilation. It is a fairly life-like scream for a robot, in a program with delicious sound effects generally.

"H.Q. to commander (your name here): Procede (sic) to and clear area 76" — and off you go with your tanks to get the mines before they get you. Minefield — 5K and 0.3K, £4.95 — is a fairly standard version of Tank — two keys change your direction of advance. You have to fire at mines before you hit them, or before they explode — and there is a time-factor running down on each mine in the field. Not an easy game.

Tangled — 5K and 0.5K, £3.95 — is a strangely named two-player version of Snake. If one player is the computer it usually wins. In each run the two snakes set off level, and then must race to "eat" a randomly plotted numeral. Fed snakes lengthen, but must not touch each other or the hazards found at higher levels, nor must they reverse direction — tricky. Basic graphics, but quite effective sound.

A & F are worth watching; they also include in their list a program for teaching the time — 5K and 0.5K, £3.95.

Bug-Byte

THIS COMPANY is not only a giant in Atom software, but in supplying the needs of other micro users. Bug-Byte's Atom software is fairly well-presented, though not cheap. There is normally no paper documentation, but some programs have "Instructions" before the recording.

Backgammon — 6K and 1K at £7 — comes first, if only because the company claims to be giving half of that price to charity. If leukaemia research is getting £3.50 from each sale, what is Bug-Byte's usual profit margin? This program is an adequate implementation of the standard game, with a clear board and fairly fast response time.

Galaxian — 6K and 6K at £8 — is somewhat less staid than Backgammon. Rightly described as another superb arcade game by the publishers, this is invaders plus. The plusses are firstly that detachments of the invader army are swooping around aiming to get you, one way or another; and secondly that the sound effects are most sophisticated. This is a superb machine-code program, definitely one of Bug-Byte's best.

Bug-Byte's Chess costs £9 and takes 12K. Compared to Acorn's, the screen display is better with graphic symbols and the co-ordinates in position, but less flexibility in entering moves. You cannot change sides in play, nor change your move during entry. I am not competent to judge this program's chess ability — but it allows and uses all legal moves. It has many levels, and a good range of unusual options.

Computer Concepts

SPACE INVADERS seems to be a standard exercise for novice programmers — well here is yet another version from a new company in the field. The file-name, charmingly, is Invaers (sic) and it costs £7.50 with instructions. These instructions deal with saving high scores and redefining the invader characters. The review copy of the program over-ran the end of the tape.

Softscreen — 6K and 6K, £11.40 — is, as the name implies, a utilities program. It brings the Atom quite a useful way towards having BBC facilities — a 40-character line, definable characters, and text windowing are offered, as are many of the BBC control codes/VDU drivers. Full instructions and demonstration are included.

Computer Concepts also have, on one £4.95 cassette with instructions, Alarm Clock and Sound Effects. These are 2K machine code routines which work on an Atom with VIA and Link 2. Alarm Clock is an interrupter kept out of the way of your main program but able to interrupt when set. Load and Save halt the clock; Break stops it. Sound effects is also a machine-code utility, with particularly difficult instructions. It is designed to allow one to program notes with great flexibility; but I suspect that in practice the trouble may be too much.

Deathsoft

THE CASSETTE came with an ill-fitting card, a hand-written note on half a sheet of file-paper and a sheet of photo-copied program details. But some of the programs in this very mixed bag are of interest, and at £2 you cannot go wrong. The programs range from 1.5K to 9K, and some need the floating-point ROM. They include an adventure, graphics games, utilities and mathematical programs.

Utility ROMs

THREE SUPPLIERS now market utility ROMSs to go in the IC24 socket on the Atom's board, with instruction booklets of variable quality to accompany them. Unplugging the Atom, removing the base, inserting the chip and reinstating the machine takes only a minute. These chips are sensitive to static charge of course, and it is interesting to see what the suppliers say about this matter.

Mr Bates, whose package comes at an impressive £9.95 says: "The ROM can be damaged by static electricity, though this is unlikely". The Psion booklet — package price £18.95 — does not even mention the matter but then it contains only half a sentence of installation instructions. Willow Software — £19.95 — makes more of a meal of the problem and advises how to earth yourself and avoid nylon carpets.

Bates' Toolkit is the cheapest. The instruction book is eight duplicated pages — brief but entirely clear. This offers Read . . . Data . . . Restore, Renumber which even works on line numbers in Rems. Auto line numbering, partial Deletion of program lines, specified string search to look for labels for instance, clear variables, dump-variable values, Chain loading, Loadgo loading, audio loading indicator, keyboard scan. There are nine new error messages.

The Psion Edit/Debug ROM gives a total of 57 commands, mostly of only one or two characters plus operands. These are mainly of importance for machine-code programmers — they include commands for register contents display, relative jumps, exchange contents of text spaces, and so on. Delete, renumber and the like are here too of course, as are simplified Load/Save commands. The printed booklet is highly condensed — practising with simple programs is the best way to master it.

Willow Software's Utility ROM has the clearest and most detailed instructions. These concern 17 facilities, including Append, Auto, Del, Find, Key and Ren. There are also useful commands to give size of current program and memory left, a key-entry bleeper, and — the reviewer's dream — a function giving a bleep when a program has loaded.

Clearly the Psion package is for the advanced machine-code programmer, and Bates' toolkit is at the other end of the spectrum.

Program type	Number
Data-handling	4
Educational	3
Finance/commercial	14
Conflict games	6
Space games	2
Space conflict games	13
Traditional games	8
Other games	41
Mathematical	7
Utilities	18
Other	10
Games	70
Non-games	56

Suppliers and addresses

Acornsoft, 4a Market Hill, Cambridge 2.
A & F Software, 10 Wilpshire Avenue, Manchester 12.
M D Bates, Dever Barn, Church Street, Micheldever, Winchester, Hampshire.
Bug-Byte, 98-100 The Albany, Old Hall Street, Liverpool 3.
Computer Concepts, 16 Wayside, Chipperfield, Hertfordshire.
Deathsoft, Chapel House, City Road, Chester.
Psion, 2 Huntsworth Mews, Gloucester Place, London NW1.
Willow Software, 87 Willow Walk, Crediton, Devon. ■

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C12		38p	
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C20		41p	
C25		43p	
C30		44p	
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EDITOR–99		9·95	·50	
CASSETTE LEAD		1·00	·20	

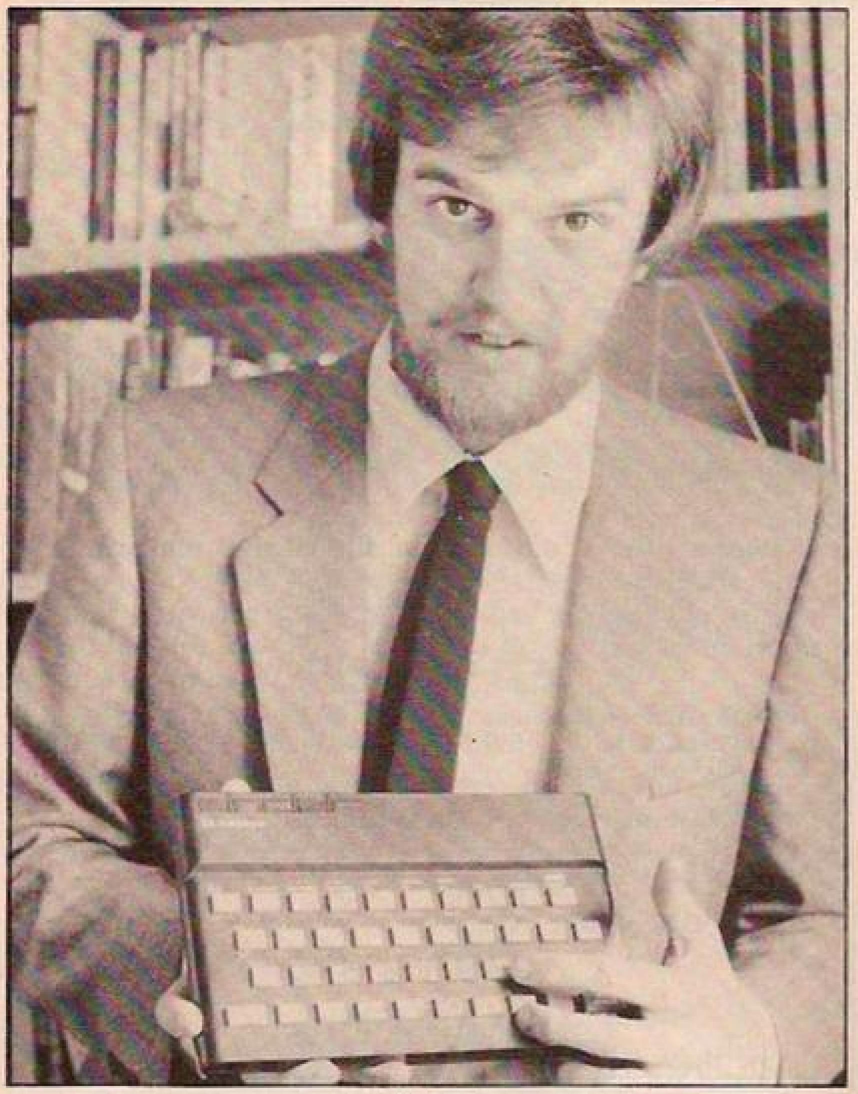
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INTERVIEW

THE ENGINEER BEH

The day after Richard Altwasser left Sinclair Research, the company had to advertise for "the world's best computer designer" to replace him. He talks to Brendon Gore about the development of Sinclair's exciting new colour computer.

OCCASIONAL WINDSURFER, sometime engineering graduate and full-time microcomputer enthusiast, Richard Altwasser was largely responsible for the development of the hardware for the Sinclair ZX Spectrum. Together with Steven Vickers, who wrote most of the ROM for the Spectrum, he was in on the launch of Sinclair's latest microcomputer from the very beginning.

Richard Altwasser graduated from Trinity College Cambridge with an honours degree in engineering in June 1978. Originally, he had planned to take up a lecturing position at a university in the Phillipines under the aegis of the VSO. But, in the end, he decided to get married and stay in the U.K.

After writing to 19 different companies, and being offered four jobs, he decided to join Metal Castings in Worcester. As the head of a small electronics team, he was responsible for installing industrial robots and for designing the company's own programmable-control and instrumentation equipment. It was, he says with just a touch of understatement, quite a novel field for electronics.

A Swedish friend first introduced Richard Altwasser to microcomputers. On his recommendation, Altwasser bought a Tandy TRS-80 and soon became hooked on the microcomputing bug. He also realised that microcomputers had potential for the work he was doing for Metal Castings.

"I demonstrated a few programs to some of the directors and persuaded the company to buy a TRS-80. I ran a short evening class for the engineers to teach them how to use the thing, and I think it proved quite useful to them".

But Richard Altwasser had become increasingly disenchanted about his career prospects with Metal Castings. The company was closely linked to the automotive industry which had suffered serious setbacks during 1979 and 1980. Consequently, the company seemed more interested in cutting back its production facilities than in developing them.

Altwasser started looking around for another job. An advertisement in the national daily press caught his eye — Sinclair was looking for an electronics engineer. This seemed an ideal opportunity, as Sinclair had made its first real venture into the microcomputing market with the launch of the ZX-80 a few months previously.

Two interviews followed Altwasser's application to join Sinclair. The first was conducted by a company of recruitment professionals. It consisted of a number of in-depth personal and technical interviews including an intelligence test and a personality profile to determine whether he was an introvert or an extrovert.

The second interview was with Clive Sinclair at Cambridge. "He invited me into his room where he had a ZX-80 and sort of ushered me to sit down", says Altwasser. "After sitting in silence for a few moments I thought I had better do something, so I started writing a little program on the ZX-80 which sparked off a bit of conversation. After a few minutes he offered me a job and I accepted it. We shook hands and that was it".

Richard Altwasser joined Sinclair on the first Monday in September 1980. He was immediately informed of two things. Firstly, Sinclair's 8K ROM, and 16K RAM pack were about to be launched. Secondly, he was told that the chief engineer was going on holiday so it was up to him to write some programs to demonstrate the capabilities of the new ROM and RAM pack.

Not surprisingly, Altwasser worked late on his first day at Sinclair. It was a pattern that was to continue for the next two years.

> **'People who work for Sinclair do not have many hobbies'**

"People who work for Sinclair do not have many hobbies", says Altwasser ruefully, "they tend to work too much".

Plans for the ZX-81 were well advanced by the time Altwasser joined Sinclair. His main contribution to the ZX-81 was designing its printed-circuit board. This brought him into contact with one of the policies that differentiates Sinclair from its rivals.

"It is a policy of Sinclair not to employ technicians", explains Altwasser. "Whereas a lot of companies employ people to draw up circuit diagrams that engineers have scratched on the back of cigarette packets, and maintain a myriad of support staff, Sinclair believed in employing engineers and letting them do all of these support tasks. So I spent a lot of time with a soldering iron literally soldering things together, building up prototypes for the ZX-81".

> **'The Vic-20 is a second-rate computer'**

After the launch of the ZX-81, Richard Altwasser was made responsible for computer development. It was a move that led directly to the birth of the Spectrum. The idea was first conceived towards the end of July, 1981. Lengthy discussions between Altwasser and other Sinclair engineers resulted in the drawing up of broad specifications for the next generation of computer. "We decided it must have high-resolution graphics, probably 16K of memory, an improved cassette interface, sound and of course most importantly colour".

"One of the first questions that we had to ask ourselves was about the display mechanism", reveals Altwasser. "On the ZX-81, the CPU is part and parcel of the display — the CPU program counter is used as the memory-address register. This means that the slow mode on the ZX-81 is the only continuously moving graphics mode and that has a CPU efficiency of only 25 percent. So we had to decide whether to continue with that sort of approach or to divorce the CPU from the display and enable it to work at full efficiency.

"We felt that with a computer that was going to have high-resolution graphics as well as colour, people would want to have fast-moving animated displays. Consequently, we decided to design a computer architecture that divorced the CPU from the display".

The next problem that Altwasser faced was how to include colour in the display. The first idea that he considered was a derivation of the teletext approach where each line of text has colour change codes inserted into it. But, while this only use a limited amount of memory, it had the disadvantage of using up a character position every time the colour needed to be changed. In addition, while this approach was suitable for graphics and teletext displays, it was not suitable for high-resolution graphs or diagrams that involved multiple colour changes.

After much head scratching, Altwasser and his fellow engineers came up with the idea of allocating a colour attribute to each character position on the screen. This used six bits of memory, three bits to provide any one of eight foreground colours and three bits for the eight background colours, for each character position. With two bits of memory still available, Altwasser decided to include a flashing mode and a highlight feature that offered two levels of intensity.

This system took up slightly less than 7K of memory, which fitted in with Altwasser's plan for a computer with 16K of dynamic RAM. The user was left with 9K of memory in which to write programs — a figure which Altwasser regarded as quite respectable.

The need for an improved cassette interface was all too clear from the number of ZX-81 users who encountered problems when trying to save and load programs. "The ZX-80/81 used a tone-burst mechanism that transmitted bursts of cycles at about 3kHz", says Altwasser. "Nine cycles represented a 1 and four cycles represented a 0. But in the Spectrum one cycle represents a 1 and a half a cycle represents a 0, which works out faster as fewer cycles are used.

"The second thing we did was to introduce a leader — that is a period of constant tone which allows the cassette recorder's automatic gain control to settle itself down. In addition, we included a Schmitt trigger inside the Spectrum ULA. This helps to eliminate noise and hiss on the tape".

Richard Altwasser was also involved ion the preliminary stages of development the ZX Microdrive, which he regards as an achievement that is at least significant as the Spectrum itself. The ZX Microdrive can store up to 100K on a micro-floppy disc, has a transfer rate of 16K a second and costs just £50. But Altwasser was unwilling to give away any secrets. His loyalty to Sinclair says much for both men.

The decision to call new machine the Spectrum and not the ZX-82 that many people had expected, was made for a number of reasons says Altwasser. "Firstly, the ZX-81 replaced the ZX-80 and the Spectrum is meant to run alongside

'The Spectrum is meant to run alongside the ZX-81'

the ZX-81 rather than replace it. Secondly, calling the Spectrum a ZX-82 creates the impression that the company will be producing a ZX-83 in the spring of 1983".

Overall, Altwasser is very pleased with the finished Spectrum. it has more than lived up to its original specifications. "It is going to sound very partisan, but as this project came together I think we were all more impressed with it than we expected to be. We started off thinking that we were developing an enhanced ZX-81, but we ended up with a new, much more adanced, creature. I was particularly pleased with the tape mechanism — we originally aimed at getting it to work at about 1,000 baud, but we succeeded in making it work at 1,500 baud which is considerably faster. I think the weaknesses of the ZX-81 were its keyboard and its lack of memory. The Spectrum has quite clearly overcome both of those problems".

Altwasser believes that the Spectrum is superior to rival machines such as the Vic-20 and Atom, but he has considerable respect for the BBC Micro. "I think there is no getting away from it, the BBC Micro is a very good machine that offers a wide range of facilities. But I do not think the BBC Micro is as friendly or easy to use a computer as the Spectrum. I think behind the Vic-20 is a very good advertising company backed up by a second-rate computer. Both the graphics and the sound are limited by the Vic-20's internal ROM software which is not really designed to deal with high-resolution graphics".

Despite the enormous interest generated by the launch of the Spectrum, Sinclair still plans to carry on making the ZX-81. But no-one is willing to predict how the advent of the Spectrum will affect future sales of the ZX-81. "This is clearly the big question, of course. Personally, I feel that the two can co-exist side by side, but obviously there are going to be many people who were going to buy the ZX-81 who are now going to buy the Spectrum instead".

Certainly Altwasser has faith in the Spectrum. He left Sinclair at the beginning of May this year to set up his own company, in conjunction

'The BBC Micro is a very good machine'

with Steven Vickers, author of the Spectrum manual. The new company, provisionally called the Rainbow Computing company, will cater for Spectrum users, but Altwasser is distinctly cagey about releasing any details of the company's plans. However, with Altwasser's knowledge of the internal workings of the Spectrum and Vickers's abilities as a software writer, it is a fairly safe bet that they will be producing a range of software and peripherals for the Spectrum.

Altwasser's abilities as a computer engineer can be judged by an advertisement that appeared in the national press the day after he left Sinclair. "Quite simply we are looking for the world's best computer designer". Altwasser is too modest to suggest that Sinclair has already lost the world's best computer designer, but he will not be easy to replace. ■

ND THE SPECTRUM



RACING

FIGHT TO THE FINISH



While the ZX-81 makes all the running, the race-track tussle reveals whether your choice of winners backs your gambling instinct. Honest Simon Lane is the bookie.

AN EVENING at a greyhound stadium can be very enjoyable, but also very expensive. This program attempts to give you the joys of an evening at the dog track without the risk of losing your shirt. Either one or two can play. The length of the meeting can be up to 12 races, and it is assumed that the first race starts at 7.45pm and the races progress from there at 15-minute intervals. Each race can be one of four distances — 320 metres, 560 metres, 800 metres or 1,040 metres. A typical race might go like this.

First you are shown the race number, the time, the date, and the distance of the race. The date has been entered earlier in the program. You are then asked to type in a command, which may be either Card, Odds, Bet, End or Help. Typing in Card displays the racecard. This gives the form for each dog over the last five races at this distance. For each of these races, the date is given together with the time in which the dog completed the race. From this information the player should be able to determine roughly how good each of the dogs is. If a printer is attached it is possible to get a hard copy of the racecard, making the game even more realistic.

Forecasts and stakes

When the player has finished with the card, he returns to command mode by typing Newline. The next command to be executed is usually Odds. This gives the player the chance to see the forecast or the win and place odds. The percentage of the win and place pools on each dog is shown, with the payout on a £1 stake for each dog on the win pool. The forecast pool odds show the amount to be won with a £1 stake on each of the 30 forecast combinations.

Once you have decided on a good bet, or a number of good bets, execute the command Bet which places as many or as few bets as you like on each of the three pools. With a win bet, the player is paid if the dog wins, and with a place bet if the dog comes in first or second. For a forecast bet you have to name both the winner and the second dog.

Type End to finish your go. In a two-player game the second player will then go, but other-



wise this will signify the start of the race. The track is displayed on the screen with the six dogs waiting in their traps. For 320- and 800-metre races the starting traps are at the top right of the track, while for 560- and 1,040-metre races they are at the bottom left of the track. The finishing post is always at the bottom right.

After a few seconds the screen goes blank, and when the picture reappears the dogs have moved a few metres. This is repeated about every 2.25 seconds, until the race is completed. Note, however, that the dogs run on for several metres after the finishing post. The results are then displayed, along with the payout on each of the win, place and forecast pools. The winnings for each player are calculated, and the total amount of money each player has is displayed. Finally the next race commences.

In my original versions of the program, there was a section from line 20 to line 570 which set up four arrays: D, A$, N$ and C$. Unfortunately, as I progressed with the program, I ran out of memory, so I ran the program up to line 570, creating the four arrays and setting up their initial values, and then erased the lines from 20 to 570 and carried on with the program. When I had completed it, I saved it on tape, still leaving the arrays intact. I was therefore able to load the program and execute it with the command Goto 0, which starts the program without destroying the arrays.

Unfortunately, this means that if the program is merely typed in as it is presented here, and it is executed either with Goto 0 or Run, the error code Z/600 will appear, as the A$ array has not been set up. I have therefore included an initialisation program to set up the four arrays. This must be used as follows:

- Type in the initialisation program.
- Run it.
- Remove the program line by line, by typing each line number in turn. Do not use New as this will destroy the four arrays.
- Type in the main program.
- Save it.

The program must then be executed by using Goto 0, as Run would clear the arrays. The program may then be executed after loading by Goto 0; it is not necessary to use the initialisation program every time.

Although the program is written for a ZX-81, it would be fairly easy to convert it for other machines and could be improved to utilise the facilities provided by the computer, e.g., by adding high-resolution graphics for the race display. Very few alterations are required to run the program on an 8K ROM ZX-80. They are:

Leave out all Fast and Slow statements.

```
3420 PAUSE 4E4
3425 POKE 16437,255
3430 GOTO 2180
```

This program and the Cubemaster program which appeared in the February edition of *Your Computer* are available on cassette for £3 each from: Simon Lane, Flat 1, Southview, 135 Hornsey Lane, London N6.

(continued on next page)

(continued from previous page)

Initialisation program

This is split into four parts; one for each array.

Lines 10-130 set up the D array, which contains the race distances, average times and the maximum deviation from this time possible.

Lines 140-210 set up the A$ array. This consists of the 256 combinations of pairs of characters with codes in the range one to 16. This array is used in the creation of the dogs' names, as there are 16 possible first halves and 16 possible second halves of names from which each name can be created. The array is randomly sorted in the main program, and elements are used for making names in order, ensuring that no name is used twice.

Lines 220-290 set up the N$ array. This consists of string representations of the numbers zero to 99, and speeds up the printing of numbers in this range, as numbers take a long time to print on the ZX-81.

Lines 300-1260 set up the C$ array. This contains all the data for printing the position of the dogs during the race. The codes of the characters provide the co-ordinations.

Main program descriptions

Line 5 puts the computer into Fast mode while the A$ array is randomly sorted.

Lines 580-630 "shuffle" the first 72 elements of the A$ array, as there are a maximum of 12 races with six dogs in each, so up to 72 different names will have to be created.

Line 640 sets the pointer into the A$ array to 1, the first element.

Lines 1000-1400 print the instructions, and Input the numbers of players (PL), the number of races (RA), the month (MO), the date (DA) and whether or not a printer is being used (P$). If a list of the commands is required, subroutine 1500 is called. The players' names are also Input into Z$.

Lines 1400-1490 set up the D$ array, containing the dates of the five preceding meetings and the current meeting.

Lines 1500-1800 print the commands and if P$ = Y, the option of a hard copy is offered.

Lines 2000-2030 give the players £100 each.

Line 2040 is the start of the race loop.

Line 2045 puts the computer into Fast mode whilst the data about the race is compiled.

Lines 2050-2080 initialise the H$ and T arrays, and the variables DI and BE. The RND is line 2070 choses a random distance.

Lines 2090-2170 create the dogs' names and their approximate times. Firstly the codes of the two characters in A$ (PO) are put into A and B. Then these numbers are converted into words. Line 2120 creates I$ from A, and line 2130 creates J$ from B. These are put together into the H$ array with an inverse space separating them. Line 2150 creates the approximate time, and line 2160 puts the dog with the fastest time into BE.

Lines 2195-2260 calculate the probabilities of winning for each dog. These are based on the fact that the greater the dog's approximate time, the less likely it is to win.

Lines 2270-2320 calculate the probabilities of coming second for each dog. These are based on the win times, and the formula in line 2300 provides an accurate approximation of these probabilities.

Lines 2330-2390 set up the T$ array with the aid of the N$ array, to give the form times in string form.

Lines 2500-2640 calculate the Y, P and O arrays which hold the information on the win and place pools. They are based around the probabilities of coming first and second, with a random element.

Lines 2650-2770 calculate the betting on the forecast pool, based on the W and S arrays.

Line 2780 creates the B array, which will hold the bets to be made by each player.

Line 2782 sets up M$, the title string for the race. It is in the form: Race time, date, distance.

Line 2800 is the start of the player loop.

Lines 2810-2817 clear the screen, print the race title with subroutine 2820, and continue the program.

Lines 2820-2835 contain the subroutine to print the title and underline it.

Lines 2840-2870 input a command from the player.

Line 2880 jumps to the relevant line number. If the player has not typed one of the legal commands, execution of the program continues with line 2890.

Lines 2890-2900 inform the player of his mistake.

Lines 2920-2930 executive the "help" command by calling the subroutine found at line 1500.

Lines 2940-3290 execute the Odds command.

Lines 2940-3040 ask the player whether he wants to see the win and place odds or the forecast odds, or if he wants to return to the command mode. A jump is then made to the relevant part of the program. Lines 3050-3160 are responsible for printing the win and place odds, and lines 3170-3290 print the forecast odds.

Lines 3300-3430 print the racecard. The "POKE 16416,0" in line 3390 allows all 24 lines of the screen to be used for printing, whilst the "POKE 16418,2" in line 3410 reserves the bottom two lines for use by Input again.

Lines 3440-3980 execute the Bet command. Lines 3451-3455 are a subroutine to print the amount of money the player has. The elaborate technique used to print the amount ensures that the pence will be displayed correctly, for example, the program will print "£21.80" instead of "£21.8". If the player has less than £1, he is prevented from betting by lines 3457-3460. Lines 3465-3560 determine which pool the player wishes to bet on, and jump as necessary.

Lines 3570-3810 input the other data required, setting up the variables B, D1, D2 and P1. Lines 3820-3840 find the next available space in the B# array, and lines 3850-3880 enter the information into it. Lines 3881-3888 are responsible for printing a betting slip if a printer is being used, and lines 3890-3940 print out all the bets that the player has made so far.

Line 4000 executes the End command. If there are two players the Player loop is executed again for the second player. Otherwise the race commences.

Lines 4010-4020 clear the screen, and allow all 24 lines of the screen to be used by Print.

Lines 4030-4260 print the race-track.

Lines 4270-4300 calculate the position of the starting traps and put the dogs in them.

Lines 4310-4340 add up the win probabilities, so that a random winner can be selected.

Lines 4350-4430 select a random winner, and dog to come second, based on the W array.

Lines 4440-4500 calculate the times for each dog. The race is based on a 2.25-second time unit which is the time interval between

The initialisation program.

```
   1 REM STADIUM(INITIALISATION)
  10 DIM D(4,3)
  20 LET D(1,1)=320
  30 LET D(1,2)=20
  40 LET D(1,3)=0.5
  50 LET D(2,1)=560
  60 LET D(2,2)=37
  70 LET D(2,3)=1
  80 LET D(3,1)=800
  90 LET D(3,2)=54
 100 LET D(3,3)=1.2
 110 LET D(4,1)=1040
 120 LET D(4,2)=70
 130 LET D(4,3)=1.5
 140 DIM A$(256,2)
 150 FOR I=1 TO 16
 160 FOR J=1 TO 16
 170 LET P=I*16+J-16
 180 LET A$(P,1)=CHR$ I
 190 LET A$(P,2)=CHR$ J
 200 NEXT J
 210 NEXT I
 220 DIM N$(100,2)
 230 FOR I=0 TO 9
 240 FOR J=0 TO 9
 250 LET P=I*10+J+1
 260 LET N$(P,1)=CHR$ (I+28)
 270 LET N$(P,2)=CHR$ (J+28)
 280 NEXT J
 290 NEXT I
 300 DIM C$(6,2,48)
 310 LET X$=""
 320 LET X$=X$+"[illegible]"
 330 LET X$=X$+"[illegible]"+CHR$ 11
 340 LET X$=X$+"£$:?(()) "
 350 LET X$=X$+"))))))))) "
 360 LET X$=X$+")) ((?:$£"
 370 LET X$=X$+CHR$ 11+"[illegible]"
 380 LET C$(1,1)=X$
 390 LET X$=""
 400 LET X$=X$+"<>) (?:$£"
 410 LET X$=X$+CHR$ 11+"[illegible]"
 420 LET X$=X$+"[illegible]"+CHR$ 11
 430 LET X$=X$+"£$:?()><"
 440 LET X$=X$+"=+-*//;;"
 450 LET X$=X$+";;//*-+="
 460 LET C$(1,2)=X$
 470 LET X$=""
 480 LET X$=X$+"[illegible]"
 490 LET X$=X$+"[illegible]"+CHR$ 11
 500 LET X$=X$+"£$:?)))>>"
 510 LET X$=X$+">>>>>>>>>"
 520 LET X$=X$+">>>>)?:$£"
 530 LET X$=X$+CHR$ 11+"[illegible]"
 540 LET C$(2,1)=X$
 550 LET X$=""
 560 LET X$=X$+"<>) (?:$£"
 570 LET X$=X$+CHR$ 11+"[illegible]"
 580 LET X$=X$+"[illegible]"+CHR$ 11
 590 LET X$=X$+"£$:?()><"
 600 LET X$=X$+"=+-*;;;;"
 610 LET X$=X$+";;;;*-+="
 620 LET C$(2,2)=X$
 630 LET X$=""
 640 LET X$=X$+"[illegible]"
 650 LET X$=X$+"[illegible]"+CHR$ 11
 660 LET X$=X$+"£:?()><<"
 670 LET X$=X$+"<<<<<<<<"
 680 LET X$=X$+"<<>)(?:£"
 690 LET X$=X$+CHR$ 11+"[illegible]"
 700 LET C$(3,1)=X$
 710 LET X$=""
 720 LET X$=X$+"<>) (?:$£"
 730 LET X$=X$+CHR$ 11+"[illegible]"
 740 LET X$=X$+"[illegible]"+CHR$ 11
 750 LET X$=X$+"£$:?()><"
 760 LET X$=X$+"=-*/;;..."
 770 LET X$=X$+"...;/*-="
 780 LET C$(3,2)=X$
 790 LET X$=""
 800 LET X$=X$+"[illegible]"
 810 LET X$=X$+"[illegible]"+CHR$ 11
 820 LET X$=X$+"£:?)><=="
 830 LET X$=X$+"========="
 840 LET X$=X$+"==<>)?:£"
 850 LET X$=X$+CHR$ 11+"[illegible]"
 860 LET C$(4,1)=X$
 870 LET X$=""
 880 LET X$=X$+"<>) (?:$£"
 890 LET X$=X$+CHR$ 11+"[illegible]"
 900 LET X$=X$+"[illegible]"+CHR$ 11
 910 LET X$=X$+"£$:?()><"
 920 LET X$=X$+"=-*;;,00"
 930 LET X$=X$+"00,;;*-="
 940 LET C$(4,2)=X$
 950 LET X$=""
 960 LET X$=X$+"[illegible]"
 970 LET X$=X$+"[illegible]"+CHR$ 11
 980 LET X$=X$+"£.(><=++"
 990 LET X$=X$+"++++++++"
1000 LET X$=X$+"++=<>(:£"
1010 LET X$=X$+CHR$ 11+"[illegible]"
1020 LET C$(5,1)=X$
1030 LET X$=""
1040 LET X$=X$+"<>) (?:$£"
1050 LET X$=X$+CHR$ 11+"[illegible]"
1060 LET X$=X$+"[illegible]"+CHR$ 11
1070 LET X$=X$+"£$:?()><"
1080 LET X$=X$+"=-/;.011"
1090 LET X$=X$+"110.;/-="
1100 LET C$(5,2)=X$
1110 LET X$=""
1120 LET X$=X$+"[illegible]"
1130 LET X$=X$+"[illegible]"
1140 LET X$=X$+"$?()=+--"
1150 LET X$=X$+"---------"
1160 LET X$=X$+"--+=)(?$"
1170 LET X$=X$+"[illegible]"
1180 LET C$(6,1)=X$
1190 LET X$=""
1200 LET X$=X$+"<>) (?:$£"
1210 LET X$=X$+"[illegible]"
1220 LET X$=X$+"[illegible]"
1230 LET X$=X$+"£$.?()><"
1240 LET X$=X$+"+*/,0122"
1250 LET X$=X$+"2210,/*+"
1260 LET C$(6,2)=X$
```

The main program.

```
  10 REM "STADIUM"
  20 REM (C) SIMON LANE, 1982
  30 FAST
  40 RAND
 580 FOR I=1 TO 72
 590 LET R=INT (RND*256+1)
 600 LET X$=A$(I)
 610 LET A$(I)=A$(R)
 620 LET A$(R)=X$
 630 NEXT I
 640 LET PO=1
1000 SLOW
1010 PRINT TAB 10;"STADIUM"
1020 PRINT TAB 10;"[illegible]"
1030 PRINT
1040 PRINT "DO YOU WANT INSTRUCT
IONS (Y/N)?"
1050 INPUT R$
1060 IF R$="N" THEN GOTO 1190
1070 PRINT AT 3,0;"  STADIUM IS
A SIMULATION OF A "
1080 PRINT "MEETING AT THE ""ZED
EXSTOU"""
1090 PRINT "GREYHOUND STADIUM. Y
OUR OBJECT"
1100 PRINT "IS TO WIN AS MUCH MO
NEY AS YOU"
1110 PRINT "CAN BY PLACING BETS
```

each change of position of the dogs. Line 4440 converts the time for the race from seconds into these units, and places the result in T1. The track is 480 metres long, and this is divided up into 48 units for the purpose of the race. Each dog usually runs four of these units every 2.25-seconds. However, to control the order in which the dogs finish, each dog is made to slow down for a certain number of times, making it run only three units for the 2.25-second period. Lines 4450-4500 calculate these numbers.

Lines 4505-4600 execute the race itself. The machine is put into fast mode in line 4505 because the race takes much longer in slow mode, and is less realistic.

Line 4510 sets up the loop to time the race. It goes down to minus one instead of nought so that the dogs will "run on". Line 4530 erases the old position for each dog by printing a space over it. Line 4540 decides whether or not the dog will slow down or not, and lines 4550-4570 calculate the new position for each dog. Finally the new position is printed by line 4580.

Lines 4610-4620 return to Slow mode and reserve the bottom two lines of the screen for Input.

Lines 4630-4670 calculate the dividends on each pool. There are no reductions.

Lines 4680-4830 print the results table, using a similar method for printing the dividends as the one used by subroutine 3451.

Lines 4835-4960 calculate how much money each player has. Line 4845 is necessary to enable subroutine 3451 to be used in line 4920.

Line 4970 starts the next race.

Lines 4980-4990 end the program.

String arrays

A$(256,2) Condensed string representation of the 256 possible greyhound names. Set up by initialisation program.

N$(100,2) String representation of the numbers 0 to 99. Set up by initialisation program.

C$(6,2,48) String representation of the co-ordinates used for displaying the race. Set up by initialisation program.

Z$(PL,16) Names of the players.

D$(6,5) String representation of the dates of the five preceding meetings, including the date of this meeting.

H$(6,13) The names of the six greyhounds.

T$(6,5,5) String representation of the form times for the greyhounds.

Numerical arrays

D(4,3) Distance, time and maximum deviation in time for each of the four distances. Set up by initialisation program.

M(PL) How much money each player has in pounds.

T(6) Approximate time for each greyhound over this distance. Used to calculate the form times.

W(6) Probability of each dog winning.

S(6) Probability of each dog coming second.

Y(6) Used initially to hold the fractions of the win pool on each dog, then re-used during the race to hold the position of each dog on the track.

P(6) The fractions of the place pool on each dog.

O(6) The expected payout on the win pool for each dog.

F(6,6) The expected payout for each forecast combination.

B(PL,10,4) The bets made by each player.

String variables

R$ Temporary string input.

P$ Whether or not a printer is being used (Y/N).

I$ Used to hold the first half of a dog's name.

J$ Used to hold the second half of a dog's name.

M$ The title string for each race, giving the distance, time, etc.

V$ Whether or not (Y/N) a hard copy of the racecard is required.

X$ Used at the beginning of the program during the random sorting of the array A$. It is also used at various stages of the program to hold the string representations of various numbers.

Numerical variables

R Used during the random sorting of the array A$.

PO The next element to be taken from A$ for the creation of a greyhound's name. Initially set to one, for the beginning of the array.

PL The number of players.

RA The number of races. Used later to hold random numbers to determine the dogs to come first and second in each race.

MO The month.

DA The date.

DI The distance of a race. 1 = 320m., 2 = 560m., 3 = 800m., 4 = 1040m.

BE The best greyhound, based on the times given in the T array. Used to determine the probability of winning and coming second for each dog.

A Numerical equivalent of the first half of a greyhound's name.

B Numerical equivalent of the second half of a greyhound's name.

T Used to total numbers in several parts of the program.

YT Used to total the amount of money bet on the win pool.

PT Used to total the amount of money bet on the place pool.

B The type of bet to be placed by a player. 1 = win, 2 = place and 3 = forecast.

D1 The dog being bet on in a win or place bet, or the first dog of a forecast combination.

D2 The second dog of a forecast combination set to zero if a win or place bet is required.

P1 The stake on a bet.

ST Position of the starting traps in a race.

WI The winner of the race.

SE The dog to come second.

TI The average time for the distance converted to the number of times a dog would have to slow down to achieve that time.

WI The payout on the win pool.

P Used to calculate P1 and P2.

P1 The payout on the place pool for the winner.

P2 The payout on the place pool for the dog to come second.

F1 The payout on the forecast pool.

P Used in association with subroutine 3451 to print the amount of money each player has.

Loop control variables

I,J General-purpose loop-control variables.

R Control variables for the race loop. Used to give the race number.

P Control variable for the player number loop.

T Used to measure the time during the race.

```
ON EACH"
1120 PRINT "RACE. EITHER ONE OR
TUO MAY PLAY"
1130 PRINT "AND YOU CAN HAVE UP
TO TUELVE"
1140 PRINT "RACES. YOU START UIT
H £100 EACH,"
1145 PRINT "AND THE MINIMUM STAK
E IS £1."
1150 PRINT "  N.B. ALL INPUTS TO
 THE"
1160 PRINT "COMPUTER MUST BE FOL
LOUED BY"
1170 PRINT """"NEU LINE""."
1180 PRINT
1190 PRINT "HOU MANY PLAYERS (1
OR 2)? ";
1200 INPUT PL
1210 IF PL>2 THEN GOTO 1200
1220 PRINT PL
1230 PRINT "HOU MANY RACES (1 TO
 12)? ";
1240 INPUT RA
1250 IF RA>12 THEN GOTO 1240
1260 PRINT RA
1261 PRINT "UHAT IS THE MONTH (1
 TO 12)? ";
1262 INPUT MO
1263 IF MO>12 THEN GOTO 1262
1264 PRINT MO
1265 PRINT "AND THE DATE (1 TO 3
1)? ";
1266 INPUT DA
1267 IF DA>31 THEN GOTO 1266
1268 PRINT DA
1270 PRINT "DO YOU HAVE A PRINTE
R (Y/N)? ";
1272 INPUT P$
1274 PRINT P$
1279 IF R$="Y" THEN GOTO 1300
1280 PRINT "DO YOU UANT A LIST O
F THE LEGAL"
1290 PRINT "COMMANDS (Y/N)?"
1292 INPUT R$
1295 IF R$="N" THEN GOTO 1310
1300 GOSUB 1500
1310 CLS
1320 DIM Z$(PL,16)
1330 FOR I=1 TO PL
1340 PRINT "PLAYER NUMBER ";I;",
 UHAT IS YOUR"
1350 PRINT "NAME ? ";
1360 INPUT Z$(I)
1370 PRINT Z$(I)
1380 PRINT
1390 NEXT I
1400 PRINT "PLEASE UAIT."
1410 DIM D$(6,5)
1420 FOR I=1 TO 6
1425 LET D$(I)=N$(DA+1)+"/"+N$(M
O+1)
1430 LET DA=DA-7
1440 IF DA>0 THEN GOTO 1480
1450 LET MO=MO-1
1460 IF MO=0 THEN LET MO=12
1470 LET DA=DA+31-3*(MO=2)-(MO=1
1 OR MO=4 OR MO=6 OR MO=9)
1480 NEXT I
1490 GOTO 2000
1500 CLS
1510 PRINT TAB 10;"COMMANDS"
1520 PRINT TAB 10;"[illegible]"
1530 PRINT
1540 PRINT "CARD  - THE RACECARD
IS DISPLAYED"
1550 PRINT "        UHICH SHOUS T
HE TIMES FOR"
1560 PRINT "        EACH DOG OVER
 THE PAST"
1570 PRINT "        FIVE UEEKS."
1590 PRINT "ODDS  - THE ODDS ARE
DISPLAYED"
1600 PRINT "        FOR EACH OF T
HE THREE"
1610 PRINT "        POOLS, UIN, P
LACE AND"
1620 PRINT "        FORCAST."
1640 PRINT "BET   - YOU ARE ALLOU
ED TO PLACE"
1650 PRINT "        A BET ON ANY
OF THE"
1660 PRINT "        THREE POOLS."
1670 PRINT "END   - YOU TERMINATE
 YOUR GO. IF"
1680 PRINT "        THERE ARE TUO
 PLAYERS THE"
1690 PRINT "        OTHER PLAYER
HAS HIS GO."
1700 PRINT "        THEN THE RACE
 STARTS."
1710 PRINT "HELP  - THE COMMANDS
ARE LISTED."
1720 PRINT
1730 IF P$="N" THEN GOTO 1780
1740 PRINT "DO YOU UANT A HARDCO
PY (Y/N)? ";
1750 INPUT R$
1755 PRINT R$
1760 IF R$="N" THEN GOTO 1780
1770 COPY
1780 PRINT "[illegible]"
1790 INPUT R$
1800 RETURN
2000 DIM M(PL)
2010 FOR I=1 TO PL
2020 LET M(I)=100
2030 NEXT I
2040 FOR R=1 TO RA
2045 FAST
2050 DIM H$(6,13)
2060 DIM T(6)
2070 LET DI=INT (RND*4+1)
2080 LET BE=1
2090 FOR I=1 TO 6
2100 LET A=CODE A$(PO,1)
2110 LET B=CODE A$(PO,2)
2120 LET I$=("[illegible]" AND A=1)+(
"[illegible]" AND A=2)+("[illegible]" AND A
=3)+("[illegible]" AND A=4)+("[illegible]"
 AND A=5)+("[illegible]" AND A=6)+("[illegible]
[illegible]" AND A=7)+("[illegible]" AND A=8)
+("[illegible]" AND A=9)+("[illegible]" AND A=1
0)+("[illegible]" AND A=11)+("[illegible]" A
ND A=12)+("[illegible]" AND A=13)+("[illegible]
[illegible]" AND A=14)+("[illegible]" AND A=15)+
("[illegible]" AND A=16)
2130 LET J$=("[illegible]" AND B=1)+("[illegible]
[illegible]" AND B=2)+("[illegible]" AND B=3)+("
[illegible]" AND B=4)+("[illegible]" AND B=5)
+("[illegible]" AND B=6)+("[illegible]" AND
B=7)+("[illegible]" AND B=8)+("[illegible]
" AND B=9)+("[illegible]" AND B=10)+("
[illegible]" AND B=11)+("[illegible]" AND B=1
2)+("[illegible]" AND B=13)+("[illegible]" A
ND B=14)+("[illegible]" AND B=15)+("[illegible]
[illegible]" AND B=16)
2140 LET H$(I)=I$+"[illegible]"+J$
2145 LET PO=PO+1
2150 LET T(I)=D(DI,2)+(RND-RND)/
2*D(DI,3)
2160 IF T(I)<T(BE) THEN LET BE=I
```

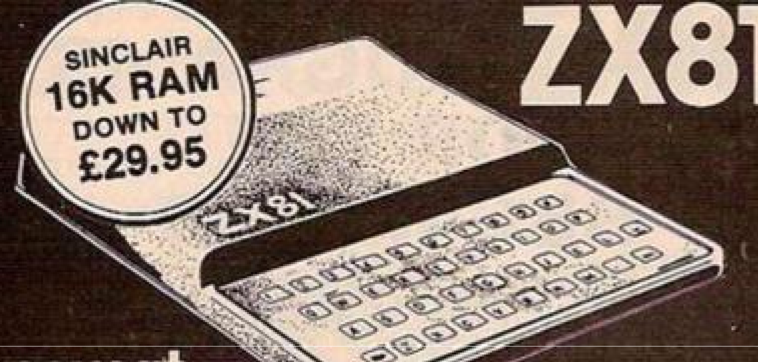
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```
2170 NEXT I
2180 DIM W(6)
2190 DIM S(6)
2195 LET T=0
2200 FOR I=1 TO 6
2210 LET W(I)=2**((T(BE)-T(I))/D(DI,3)*4)
2220 LET T=T+W(I)
2230 NEXT I
2240 FOR I=1 TO 6
2250 LET W(I)=W(I)/T
2260 NEXT I
2270 FOR I=1 TO 6
2280 FOR J=1 TO 6
2290 IF J=I THEN GOTO 2310
2300 LET S(I)=S(I)+W(I)/(1-W(J))*W(J)
2310 NEXT J
2320 NEXT I
2330 DIM T$(6,5,5)
2340 FOR I=1 TO 6
2350 FOR J=1 TO 5
2360 LET T=T(I)+(RND-RND)/2*D(DI,3)
2365 LET T=INT (T*100+.5)/100
2370 LET T$(I,J)=N$(INT T+1)+"."+N$((T-INT T)*100+1)
2380 NEXT J
2390 NEXT I
2500 DIM Y(6)
2510 DIM P(6)
2515 DIM O(6)
2520 LET YT=0
2530 LET PT=0
2540 FOR I=1 TO 6
2550 LET Y(I)=W(I)*(5+RND)/(5+RND)
2560 LET P(I)=(W(I)+S(I))/2*(5+RND)/(5+RND)
2570 LET YT=YT+Y(I)
2580 LET PT=PT+P(I)
2590 NEXT I
2600 FOR I=1 TO 6
2610 LET Y(I)=Y(I)/YT
2620 LET P(I)=P(I)/PT
2630 LET O(I)=INT (100/Y(I)+.5)/100
2640 NEXT I
2650 DIM F(6,6)
2655 LET T=0
2660 FOR I=1 TO 6
2670 FOR J=1 TO 6
2680 IF J=I THEN GOTO 2710
2690 LET F(I,J)=W(J)/(1-W(I))*W(I)*(5+RND)/(5+RND)
2700 LET T=T+F(I,J)
2710 NEXT J
2720 NEXT I
2730 FOR I=1 TO 6
2740 FOR J=1 TO 6
2745 IF J=I THEN GOTO 2760
2750 LET F(I,J)=INT (T/F(I,J)*100+.5)/100
2760 NEXT J
2770 NEXT I
2780 DIM B(PL,10,4)
2782 LET M$="RACE "+STR$ R+"  "+STR$ INT (R/4+7.51)+"."+N$((R+2-INT ((R+2)/4)*4)*15+1)+", "+D$(1)+"  "+STR$ D(DI,1)+"M"
2785 CLS
2790 SLOW
2800 FOR P=1 TO PL
2810 CLS
2815 GOSUB 2820
2817 GOTO 2840
2820 PRINT "  ";M$
2830 PRINT "  ";"▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀"(1 TO LEN M$)
2835 RETURN
2840 PRINT ,,,,,,"PLAYER ";P;", ";Z$(P)
2860 PRINT ,,,,,,"  COMMANDS"
2870 INPUT R$
2880 GOTO 2890+(30 AND R$="HELP")+(50 AND R$="ODDS")+(410 AND R$="CARD")+(550 AND R$="BET")+(1110 AND R$="END")
2890 PRINT ,,"""";R$;""" IS NOT A LEGAL COMMAND."
2900 GOTO 2870
2920 GOSUB 1500
2930 GOTO 2810
2940 CLS
2950 GOSUB 2820
2960 PRINT ,,,,"WHICH ODDS:"
2970 PRINT ,,"  WP   - WIN AND PLACE"
2980 PRINT "  F    - FORECAST"
2990 PRINT "  RET  - RETURN TO COMMAND MODE"
3000 INPUT R$
3010 IF R$="RET" THEN GOTO 2810
3020 IF R$="WP" THEN GOTO 3050
3030 IF R$="F" THEN GOTO 3170
3040 GOTO 3000
3050 CLS
3060 GOSUB 2820
3070 PRINT ,,TAB 5;"WIN";TAB 25;"PLACE"
3080 PRINT TAB 5;"▀▀▀";TAB 25;"▀▀▀▀▀"
3090 PRINT ,,"     0/0  PER £1.00";TAB 26;"0/0"
3100 PRINT
3110 FOR I=1 TO 6
3120 PRINT "123456"(I);": ";N$(Y(I)*100+1);"   £";N$(INT O(I)+1);".";N$((O(I)-INT O(I))*100+1);TAB 25;"123456"(I);": ";N$(P(I)*100+1)
3130 NEXT I
3140 PRINT ,,"TYPE NEW LINE"
3150 INPUT R$
3160 GOTO 2940
3170 CLS
3180 GOSUB 2820
3190 PRINT ,,TAB 10;"FORECAST"
3200 PRINT TAB 10;"▀▀▀▀▀▀▀▀"
3210 FOR I=1 TO 6
3220 FOR J=1 TO 6
3230 IF J=I THEN GOTO 3250
3240 PRINT "123456"(I);":";"123456"(J);" £";" 123456789"(INT (F(I,J)/100)+1);N$(INT F(I,J)-INT (F(I,J)/100)*100+1);".";N$((F(I,J)-INT F(I,J))*100+1),
3250 NEXT J
3260 NEXT I
3270 PRINT "TYPE NEW LINE"
3280 INPUT R$
3290 GOTO 2940
3300 CLS
3301 IF P$="N" THEN GOTO 3310
3302 PRINT "DO YOU WANT A HARDCOPY?"
3303 INPUT V$
3304 CLS
3310 PRINT M$
3320 FOR I=1 TO 5 STEP 2
3330 PRINT "--------------------------------"
3340 PRINT "▐▌▐▌▐▌"(I);"▐▌";H$(I);"  ";"▐▌▐▌▐▌"(I);"▐▌";H$(I+1)
3350 FOR J=1 TO 5
3360 PRINT D$(J+1);" ";T$(I,J);" SEC  ";D$(J+1);" ";T$(I+1,J);" SEC"
3370 NEXT J
3380 NEXT I
3385 IF V$="Y" THEN COPY
3390 POKE 16418,0
3400 PRINT ,,"TYPE NEW LINE"
3410 POKE 16418,2
3420 IF INKEY$=CHR$ 118 THEN GOTO 2810
3430 GOTO 3420
3440 CLS
3445 GOSUB 2820
3449 GOSUB 3451
3450 GOTO 3457
3451 LET X$=STR$ (M(P)+.001)
3452 LET X$=X$(1 TO LEN X$-1)
3453 IF X$(1)="." THEN LET X$="0"+X$
3454 PRINT ,,"YOU HAVE £";X$;"."
3455 RETURN
3457 IF M(P)>=1 THEN GOTO 3465
3458 PRINT ,,"YOU CAN NOT BET."
3459 PAUSE 50
3460 GOTO 2810
3465 PRINT ,,,,"WHICH POOL:"
3470 PRINT ,,"W   - WIN POOL"
3480 PRINT "P   - PLACE POOL"
3490 PRINT "F   - FORECAST POOL"
3500 PRINT "RET - RETURN TO COMMAND MODE"
3510 INPUT R$
3520 IF R$="W" THEN GOTO 3570
3530 IF R$="P" THEN GOTO 3600
3540 IF R$="F" THEN GOTO 3710
3550 IF R$="RET" THEN GOTO 2810
3560 GOTO 3510
3570 PRINT ,,"WIN POOL."
3580 LET B=1
3590 GOTO 3620
3600 PRINT ,,"PLACE POOL."
3610 LET B=2
3620 PRINT ,,"WHICH DOG (1 TO 6)? ";
3630 INPUT D1
3640 IF D1>6 THEN GOTO 3630
3645 PRINT D1
3650 LET D2=0
3660 PRINT ,,"WHAT STAKE (IN WHOLE £/S)? ";
3670 INPUT P1
3680 IF P1>M(P) OR P1<>INT P1 THEN GOTO 3670
3690 PRINT P1
3695 LET M(P)=M(P)-P1
3700 GOTO 3820
3710 PRINT ,,"FORECAST POOL."
3720 LET B=3
3730 PRINT ,,"WHICH DOG FIRST (1 TO 6)? ";
3740 INPUT D1
3750 IF D1>6 THEN GOTO 3740
3760 PRINT D1
3770 PRINT ,,"WHICH DOG SECOND (1 TO 6)? ";
3780 INPUT D2
3790 IF D2>6 THEN GOTO 3780
3800 PRINT D2
3810 GOTO 3660
3820 FOR I=1 TO 10
3830 IF B(P,I,1)=0 THEN GOTO 3850
3840 NEXT I
3850 LET B(P,I,1)=B
3860 LET B(P,I,2)=D1
3870 LET B(P,I,3)=D2
3880 LET B(P,I,4)=P1
3881 IF P$="N" THEN GOTO 3890
3882 LPRINT "********************************"
3883 LPRINT "*";TAB 31;"*"
3884 LPRINT "* ";M$;TAB 31;"*"
3885 LPRINT "*";TAB 31;"*"
3886 LPRINT "* ";"WIN" AND B(P,I,1)=1;"PLACE" AND B(P,I,1)=2;"FORECAST" AND B(P,I,1)=3;" ";"123456"(B(P,I,2));" AND "+"123456"(B(P,I,3)+1) AND B(P,I,1)=3;", £";B(P,I,4);TAB 31;"*"
3887 LPRINT "*";TAB 31;"*"
3888 LPRINT "********************************",,,,,,,,
3890 CLS
3900 PRINT "YOUR BETS SO FAR:"
3910 PRINT
3920 FOR I=1 TO I
3930 PRINT "WIN" AND B(P,I,1)=1;"PLACE" AND B(P,I,1)=2;"FORECAST" AND B(P,I,1)=3;" ";"123456"(B(P,I,2));" AND "+"123456"(B(P,I,3)+1) AND B(P,I,1)=3;", £";B(P,I,4)
3940 NEXT I
3950 PRINT
3960 PRINT "TYPE NEW LINE"
3970 INPUT R$
3980 GOTO 3440
4000 NEXT P
4010 CLS
4020 POKE 16418,0
4030 PRINT TAB 8;"▄▄▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▄▄"
4040 PRINT TAB 6;"▄▀";TAB 24;"▀▄"
4050 PRINT TAB 4;"▄▀";TAB 26;"▀▄"
4060 PRINT "   ▄▀";TAB 27;"▀▄"
4070 PRINT "  ▄▀";TAB 28;"▀▄"
4080 PRINT "  ▌";TAB 29;"▐"
4090 PRINT " ▄▀";TAB 30;"▀▄"
4100 PRINT " ▌";TAB 10;"▀▀▀▀▀▀▀▀▀▀▀▀";TAB 30;"▐"
4110 PRINT "▌";TAB 9;"▄▀";TAB 21;"▀▄";TAB 31;"▐"
4120 PRINT "▌";TAB 8;"▄▀";TAB 23;"▀▄";TAB 31;"▐"
4130 PRINT "▌";TAB 7;"▌";TAB 23;"▀▄";TAB 31;"▐"
4140 PRINT "▌";TAB 7;"▐";TAB 24;"▌";TAB 31;"▐"
4150 PRINT "▌";TAB 7;"▐";TAB 24;"▌";TAB 31;"▐"
4160 PRINT "▌";TAB 7;"▀▄";TAB 23;"▄▀";TAB 31;"▐"
4170 PRINT "▀▄";TAB 8;"▀▄";TAB 19;"▌  ▄▀";TAB 31;"▄▀"
4180 PRINT " ▌";TAB 9;"▀▄";TAB 19;"▌ ▄▀";TAB 31;"▌"
4190 PRINT " ▌";TAB 10;"▀▀▀▀▀▀▀▀▀▀▀▀";TAB 30;"▐"
4200 PRINT " ▀▄";TAB 30;"▄▀"
4210 PRINT "  ▀▄";TAB 29;"▐"
4220 PRINT "   ▀▄";TAB 28;"▄▀"
4230 PRINT "    ▀▄";TAB 27;"▄▀"
4240 PRINT TAB 4;"▀▄";TAB 26;"▄▀"
4250 PRINT TAB 6;"▀▄";TAB 24;"▄▀"
4260 PRINT TAB 8;"▀▀▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▀▀"
4270 LET ST=1+(24 AND (D(DI,1)=550 OR D(DI,1)=1040))
4280 FOR I=1 TO 6
4290 LET Y(I)=ST
4295 PRINT AT CODE C$(I,1,ST),CODE C$(I,2,ST);"123456"(I)
4300 NEXT I
4310 FOR I=2 TO 6
4320 LET W(I)=W(I)+W(I-1)
4330 LET S(I)=S(I)+S(I-1)
4340 NEXT I
4350 LET RA=RND
4360 FOR I=1 TO 6
4370 IF RA>W(I) THEN NEXT I
4380 LET WI=I
4390 LET RA=RND
4400 FOR I=1 TO 6
4410 IF RA>S(I) THEN NEXT I
4420 LET SE=I
4430 IF SE=WI THEN GOTO 4390
4440 LET TI=INT (D(DI,2)/2.25+.5)
4450 LET T(WI)=TI*4-D(DI,1)/10+1
4460 LET T(SE)=T(WI)+INT (1+2*RND)
4470 FOR I=1 TO 6
4480 IF I=WI OR I=SE THEN GOTO 4500
4490 LET T(I)=T(SE)+INT (RND*2+1)
4500 NEXT I
4505 FAST
4510 FOR T=TI TO -1 STEP -1
4520 FOR I=1 TO 6
4530 PRINT AT CODE C$(I,1,Y(I)),CODE C$(I,2,Y(I));" "
4540 IF RND>=T(I)/(T-1E-5) THEN GOTO 4570
4550 LET T(I)=T(I)-1
4555 LET Y(I)=Y(I)+3-(48 AND Y(I)>=45)
4560 GOTO 4580
4570 LET Y(I)=Y(I)+4-(48 AND Y(I)>=45)
4580 PRINT AT CODE C$(I,1,Y(I)),CODE C$(I,2,Y(I));"123456"(I)
4590 NEXT I
4592 PAUSE 75
4595 POKE 16437,255
4600 NEXT T
4610 SLOW
4620 POKE 16418,2
4630 LET W1=INT ((O(WI)-1)*(10+RND)/(10+RND)*100+100.5)/100
4640 LET P=1-P(WI)-P(SE)
4650 LET P1=INT ((1/(P/2+P(WI))-1)*(10+RND)/(10+RND)*100+100.5)/100
4660 LET P2=INT ((1/(P/2+P(SE))-1)*(10+RND)/(10+RND)*100+100.5)/100
4670 LET F1=INT ((F(WI,SE)-1)*(10+RND)/(10+RND)*100+.5)/100
4680 CLS
4690 GOSUB 2820
4700 PRINT ,,"FIRST:  TRAP ";WI;", ";H$(WI)
4710 PRINT "SECOND: TRAP ";SE;", ";H$(SE)
4720 PRINT ,,,,"WIN POOL    PLACE POOL  FORECAST"
4730 LET X$=STR$ (W1+.001)
4740 PRINT ,,WI;": £";X$(1 TO LEN X$-1);TAB 12;
4750 LET X$=STR$ (P1+.001)
4760 PRINT WI;": £";X$(1 TO LEN X$-1);TAB 24;
4770 PRINT WI;" AND ";SE;":"
4780 LET X$=STR$ (P2+.001)
4790 PRINT TAB 12;SE;": £";X$(1 TO LEN X$-1);TAB 24;
4800 LET X$=STR$ (F1+.001)
4810 PRINT "£";X$(1 TO LEN X$-1)
4820 PRINT ,,,,,,"TYPE NEW LINE"
4830 INPUT R$
4835 CLS
4840 FOR I=1 TO PL
4845 LET P=I
4850 FOR J=1 TO 10
4860 IF B(I,J,1)=0 THEN GOTO 4910
4870 IF B(I,J,1)=1 AND B(I,J,2)=WI THEN LET M(I)=M(I)+W1*B(I,J,4)
4880 IF B(I,J,1)=2 AND B(I,J,2)=WI THEN LET M(I)=M(I)+P1*B(I,J,4)
4890 IF B(I,J,1)=2 AND B(I,J,2)=SE THEN LET M(I)=M(I)+P2*B(I,J,4)
4900 IF B(I,J,1)=3 AND B(I,J,2)=WI AND B(I,J,3)=SE THEN LET M(I)=M(I)+F1*B(I,J,4)
4905 NEXT J
4907 LET M(I)=INT (M(I)*100+.5)/100
4910 PRINT "PLAYER ";I;", ";Z$(I)
4920 GOSUB 3451
4930 PRINT
4940 NEXT I
4950 PRINT "TYPE NEW LINE"
4960 INPUT R$
4970 NEXT R
4980 CLS
4990 PRINT "THE END..."
4995 STOP
5000 SAVE "STADIUM"
5010 GOTO 0
```

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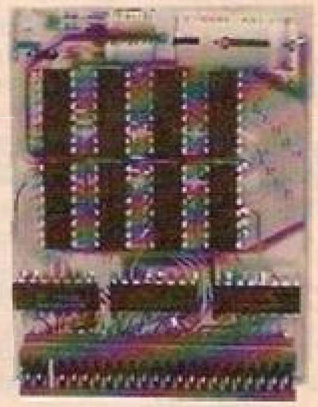
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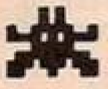
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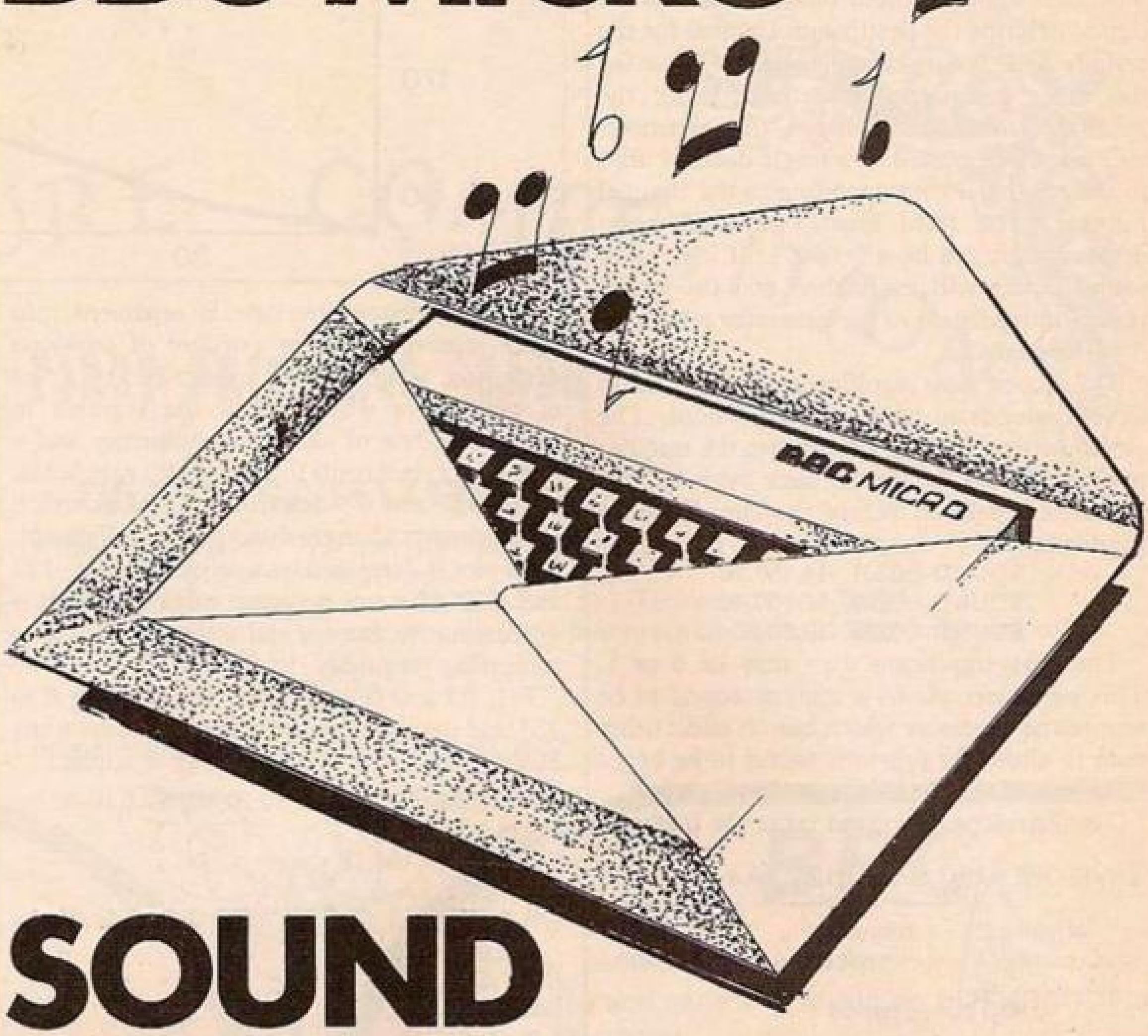
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BBC MICRO



SOUND AND ENVELOPE

Mark Holmes' explanation of the BBC Micro's Sound and Envelope commands is in sharp counterpoint to the inadequacies of the manual and pushes your machine towards concert pitch.

MANY BBC Micro enthusiasts have been disappointed at the lack of information on the sound generator in the users' guide. Disappointment turns to dismay on discovering that the noise-producing programs on the *Welcome* cassette were created using a short machine-code routine accessing the memory-mapped SN76489 directly.

The sound generator provides four independent channels, three of which produce independently-programmable square waves while the fourth can be programmed to produce either grey noise or a pulse wave. The power of the system lies not in the choice of chip, but in the software which handles the control of the chip. Once a sound is programmed and initiated, the microprocessor is returned to the user. Updating of the sound is achieved by interruption of the processor when required. This enables complex sounds to be generated requiring extensive control with the minimum of awareness from the programmer.

The two Basic control commands for the generator are Sound and Envelope. Sound causes a second request to be added to the sound buffer and thus queued for output. The sound buffer can store up to four sounds for each channel plus the one currently executing. Sound is described by one 16-bit parameter and three single-byte parameters.

The Envelope command is described by 14 single-byte parameters defining frequency (pitch) and amplitude (volume) envelopes for a sound. An envelope is a description of how a sound varies in note and volume: a full appreciation of how the shape of the envelope affects the sounds produced can only really be gained through experimentation and the process of trial and error.

The Sound command can be used either to produce a sound of constant frequency and amplitude or to produce a sound predefined by the use of the Envelope command. Type in

```
SOUND 1, -15, 10, 100
```

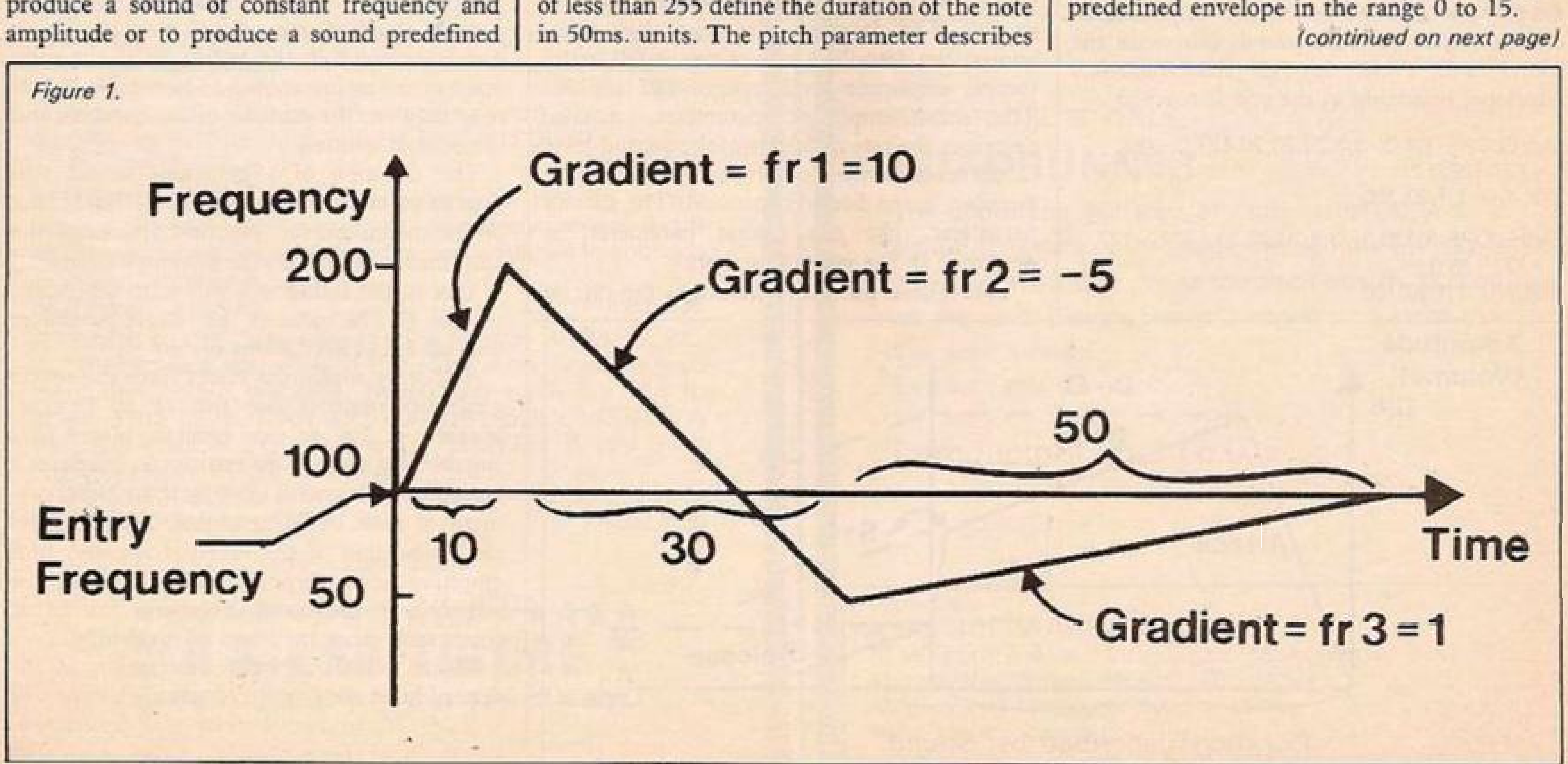
for example to produce a long low-pitched note. 1 is the channel number, −15 is the amplitude, 10 is the pitch and 100 is the duration.

The duration can range from 0-255; a value of 255 gives a note without end and durations of less than 255 define the duration of the note in 50ms. units. The pitch parameter describes the initial frequency of the sound within a range of 0 to 255. The available preset frequencies are based on quarter semitones.

The amplitude or envelope number can be used either to describe the amplitude of a note of constant pitch and amplitude if it is a number in the range −16 to −1 or to identify a predefined envelope in the range 0 to 15.

(continued on next page)

Figure 1.



(continued from previous page)

The channel parameter is a two-byte value passing four separate items of information. The least-significant four bits, or hexadecimal digits, describe the destination channel for the sound. As 0 is a reasonable default value for the other sub-parameters, these being the other three hexadecimal digits, this parameter will mostly be passed as a single decimal digit in the range 0-3 corresponding to the channel number. The third most significant hexadecimal digit can be a 0 or a 1. If it is 1 the sound buffer will be flushed and the sound passed immediately to the generator otherwise it will be queued.

The second most significant digit enables up to four sounds to be played as a chord. The value, between 1 and 3, describes the number of other sounds having the same value for this parameter required before the chord can be sounded.

```
SOUND &0201,-14,150,20
SOUND &0202,-12,100,40
SOUND &0203,-10,50,60
```

The most-significant digit may be 0 or 1. This parameter allows a dummy sound to be sent to the generator which has no effect other than to allow the previous sound to be heard fully when it might otherwise be truncated.

The Envelope command takes the form

```
ENVELOPE n,t,fr1,fr2,fr3,ft1,ft2,ft3,a,d,s,r,11,12
```

envelope number — time-based period — frequency envelope — amplitude envelope

The first parameter is an index in the range 0 to 15 which identifies the envelope, as used for the Sound command.

The second parameter in the range 1-127 describes the time intervals at which the envelope is updated in units of 10ms. This will normally be 1 allowing rapid changes in the envelope but longer more extended sounds are possible by using greater values for this parameter. If the top bit of this parameter is set the frequency envelope will only be run through once even if the end of the frequency envelope is reached before the amplitude or duration terminate the sound; otherwise the sound will cycle through the frequency envelope, restarting as the end is reached.

```
ENVELOPE 1,1,3,-3,3,20,20,20,127,0,-127,
 -127,126,0
SOUND 1,1,30,100
```

```
ENVELOPE 1,129,3,-3,3,20,20,20,127,0,-127,
 -127,126,0
SOUND 1,1,30,100
```

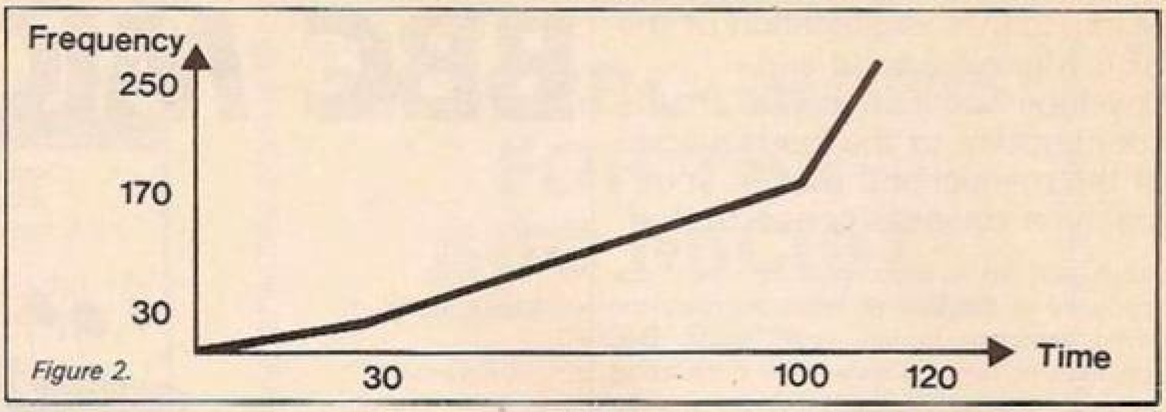


Figure 2.

The frequency envelope is separated into three segments for the purpose of envelope definition. Each segment is described by a pair of parameters which define the segment in terms of a rate of change of frequency and a number of time units for which this rate holds.

Fr1, fr2 and fr3 describe the rate at which the frequency changes during a given segment. This rate is described by a value between -127 and 127 where a negative value describes a decreasing frequency, and a positive value an increasing frequency.

Ft1, ft2 and ft3 are values in the range 0 to 255 and describe the number of timebase units during which the rate of change is applied.

```
ENVELOPE 1,1,10,-5,1,10,30,50,127,0,0,-127,
 126,0
SOUND 1,1,100,18
```

See figure 1.

```
ENVELOPE 1,1,1,2,4,30,70,20,127,0,0,-127,
 126,0
SOUND 1,1,0,24
```

See figure 2.

If a large rate of change is used over a long period the sound will cycle through the range of frequencies several times creating some interesting effects.

The amplitude envelope follows the pattern used by some other sound-generating devices, that is the ADSR system, attack, decay, sustain, release. The first four parameters of the amplitude section correspond to these elements and the final two parameters describe the amplitude levels at points within the envelope. The attack parameter describes the rate at which the amplitude rises to level one, range 1 to 127. The decay parameter, a slight misnomer, can describe a rate of rise or fall to the second amplitude level, range -127 to 127. The third amplitude parameter, sustain, describes the rate of fall from the second level to the end of the sound as defined by the duration in the Sound command. The sustain parameter, like the release parameter, is described in the range 0 to 127.

The release parameter describes the rate of fall of the sound after the official end of the sound. This part may be truncated by a following sound in the same channel and so the use of a dummy sound may be called for.

```
ENVELOPE 1,4,0,0,0,0,0,0,5,-1,-10,-1,126,60
SOUND 1,1,50,60
```

See figure 3.

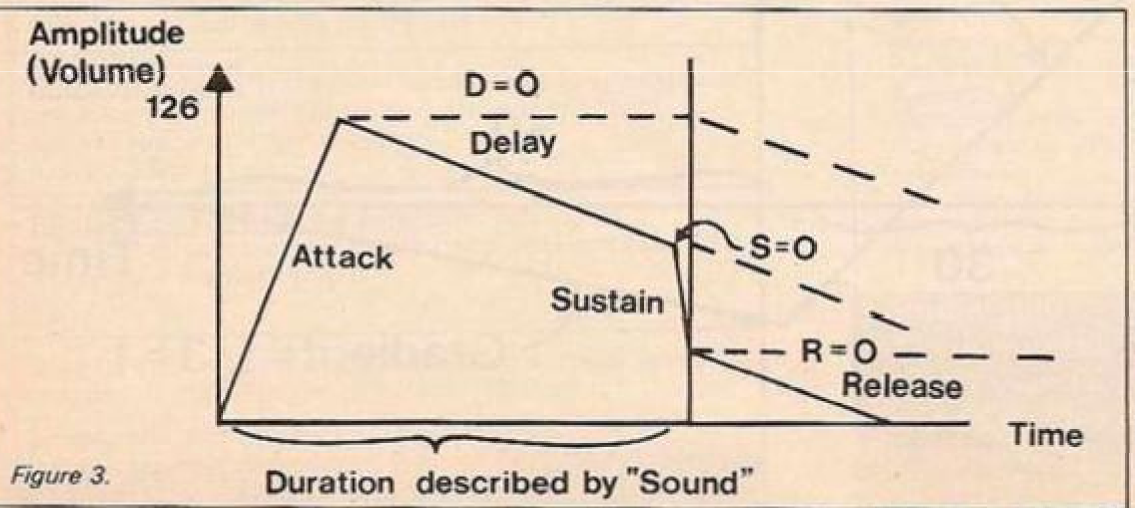


Figure 3.

If the value of decay is 0 the sound will continue at an amplitude set by level 1 until the end of the sound. If the value of sustain is 0 then the sound will continue at level 2. If the value of the release parameter is 0 the pitch and amplitude reached at the end of the duration will be continued ad infinitum.

Channel 0, the noise channel, is controlled principally via the pitch parameter of the sound command. If bit 2 of this parameter is set then the channel will produce grey noise otherwise it will produce a pulse wave. Bits 0 and 1 control the frequency of a pulse wave. If both bits are set then frequency will be linked to the frequency of channel 1.

```
10 ENVELOPE 1,1,-1,1,-1,40,40,40,127,0,0,0,
   20,0
20 SOUND 1,1,30,40
30 TIME=0: REPEAT UNTIL TIME>500
40 FOR I=0 TO 7
50 SOUND 0,-15,I,100
60 PRINT I
70 NEXT I
```

This short program demonstrates what sounds can be made via the noise channel. The For-Next loop index used to provide the different values for the pitch parameter of Sound is printed out as each Sound is placed in the sound buffer. The first five values are rapidly printed as the sound buffer fills up. Subsequent numbers are printed more slowly as vacancies occur in the buffer on the termination of the earlier sounds. There is no synchrony between the printing of the numbers and the sounds emitted.

The duration of a generated sound will depend on either the duration as defined in the Sound command or the description of the amplitude envelope in the Envelope command — that is, the sound will end if the amplitude reaches 0. The value of the release parameter will have no effect if this occurs.

Achieving maximum effect from the sound generator requires the use of an external speaker. A 3in. or 4in. speaker, placed in a suitable box or tube for resonance, produces a considerable increase in volume and improvement in tone. A 3.5mm. jack-socket enables the connection of the external speaker, hi-fi amplifier or an earphone. The latter may be advisable if the computer shares the living room with other members of the family.

Armed with this brief description of the operation of the sound commands I hope you will go on to realise fully the power and flexibility of this facility. ■

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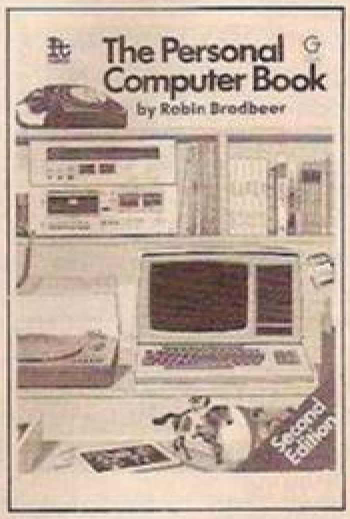
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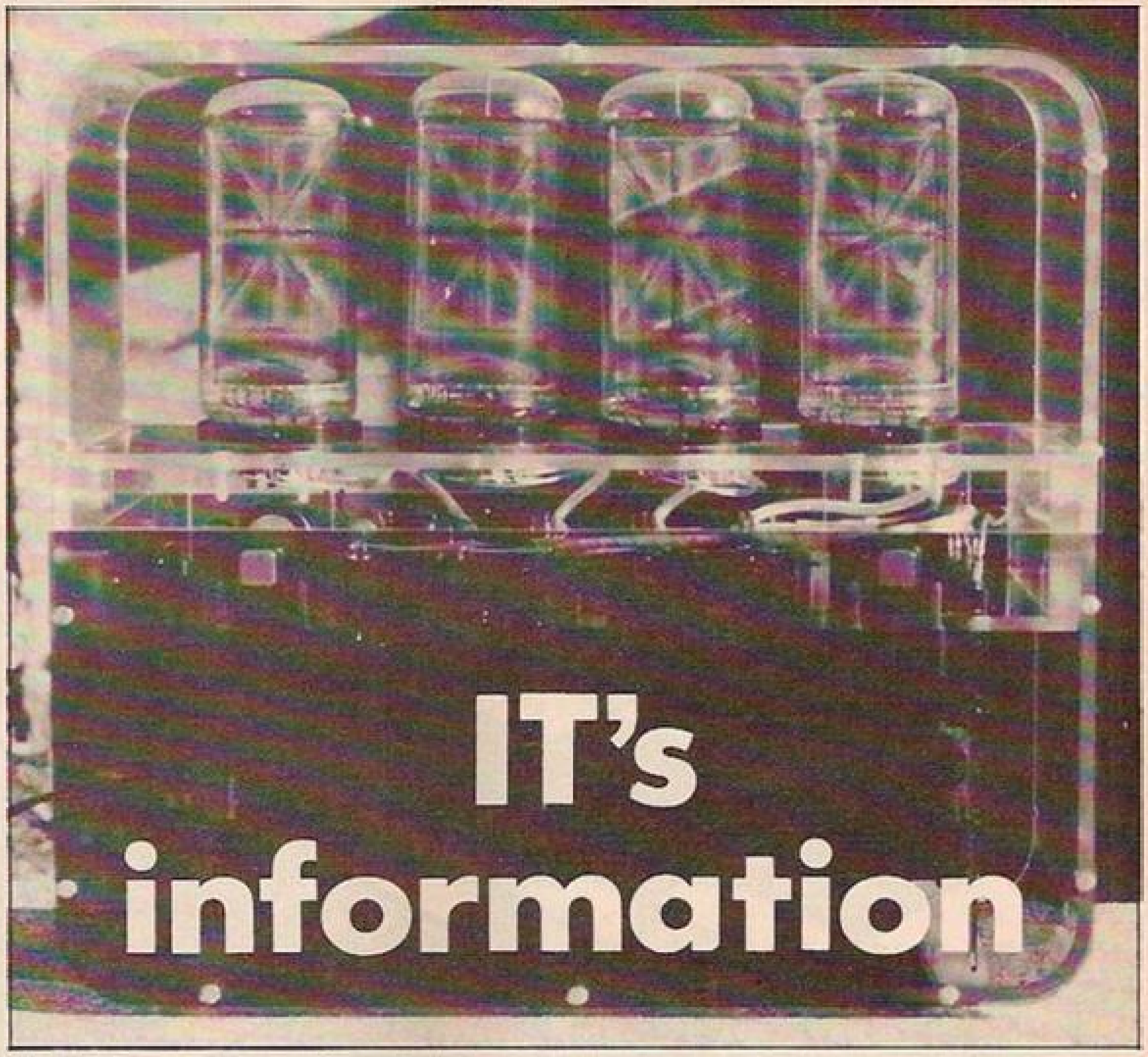


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What are Nixie tubes from the Toronto Stock Exchange doing in an art exhibition? Brian Smith argues that the bizarre uses to which information technology is sometimes put could lead to friendlier presentation of data — soon your Spectrum or BBC Micro could help you come to decisions just like a sympathetic friend.



IT's information

INFORMATION TECHNOLOGY means computers, their peripherals, and some of the ways in which they can be used to manipulate and present information. Little enough research is done on the visual presentation of information; and even less on the ways in which we actually make sense of the data presented to us.

Although a number of programs are now available that will show business users everything they might want to know about the current state of their fortunes, most take little account of what the users do with the information that appears on the screen.

Human beings see and hear what they want, or expect to see and hear. Our brains are at their most inventive when trying to wriggle away from some psychologically unpalatable truth. If we cannot avoid reality, then we change our values and judgements to make everything fit. This may be necessary for survival, but it is not the best way to approach computer aids that are supposed to model situations and answer "What if. . .?" questions.

The following program may help to convince you that we do invent parts of the world we see. It is probably the shortest psychological program ever. Using the simple print statement below, set up a cross and a circle on the screen. It works best if you use black or a colour, on white — but any colours should do the trick.

```
10 PRINT"          x          o"
20 END
```

Space out the symbols so that they are about six inches apart on the screen.

First, close your left eye, and look at the screen with your right eye. Concentrate on the cross, but be aware that you can see the circle. Now, move your head back and forth, so that you vary the distance of your eye from the screen. At a certain point, the circle should disappear.

This is the well-known blind spot trick. The theory is that you cause the circle to fall exactly on the blind spot — the part of the otherwise light-sensitive back of the eye where the nerves from all the receptor cells bunch together before feeding into the brain through the optic nerve.

The brain invents white screen, or a colour, or paper, matching the rest of the background, to fill in the part it cannot see. Otherwise, on a light background, you should still see a dark spot, because the blind spot is blind. If you try it out on closely patterned paper such as graph paper, the brain gets a bit confused, and either a grey splodge or a flicker results.

Your brain has invented a little bit of the world. This is quite enough, logically, to destroy the argument that there is a real world out there, that we can perceive and make sense of. We see it with our brain, more than with our eyes. And our brain lies to us.

To make a virtue out of a necessity, maybe we should write programs that make allowances for our ability to picture things in the way that previous experience tells us is appropriate.

The computer would know about your previous interactions with the program. So if a trend was slightly up or down, it might exaggerate it so that it stood out in comparison with previous runs. It would be hard to do this using numbers — one could almost say that the computer would be lying — but if the information is presented graphically, then the dimensions and scaling factors can change, or colour and line quality might be subtly manipulated in order to achieve the desired result.

If each program assumed that one sort of person, in one mental state, was to use it then we would be in trouble. So the computer must allow you to play with it and then gain an understanding of what you mean by the words you use, and what you are making of the data.

There are already programs for mainframes that will take into account the previous history of interactions, in the context of judgement analysis, and will act accordingly. We will not have to wait long before programs will be available on machines like the BBC Micro and Spectrum that will help you to come to a decision about masses of information contained in store, and will do so rather as a sympathetic friend might. ■

But is it art?

RECENTLY A SHOW of the work of artists and musicians who use computers has been touring Europe.

Norman White showed Matrix Four, consisting of four tubes normally used to present information on the Toronto Stock Exchange. Neon streaks glow in certain combinations to give the desired numerals or letters.

White connected these to a small computer so that only one segment at a time in each tube was illuminated. A semaphore-like effect was achieved by using parts radiating from the centre.

At the exhibition people watched what were no more than four neon lines, a few centimetres long, for great lengths of time, trying to work out the logic.

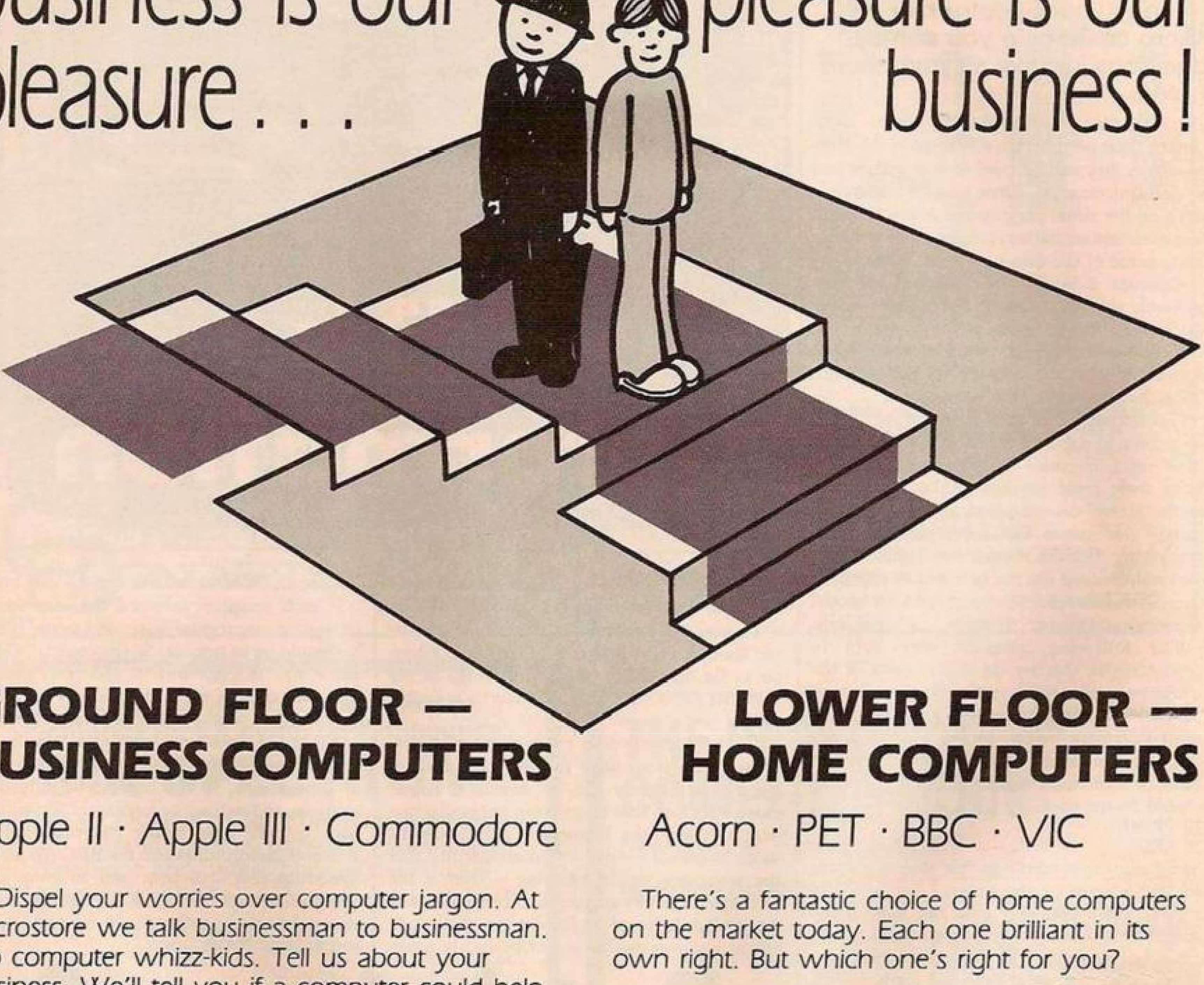
Our brains love that sort of challenge, if presented in the right context. Yet try to make similar sense out of a number of variables linked to a computer model of the economy, and it seems far harder. Much can be learned from the bizarre uses to which computers are sometimes put.

Another White work was called *Facing out, laying low.* The device watched with a cluster of electronic eyes, and could swivel and turn in many directions. Normally it sat quietly, but if you passed in front, it would move to follow you, and look you up and down. If really worried, it would chatter in high-pitched musical tones. These sounds grew more frenetic the more this paranoid electronic gangster thought it was being observed, and eventually turned into babbling hysteria.

This computer gave every impression of life, even though all the wiring was visible inside its clear perspex case. ■

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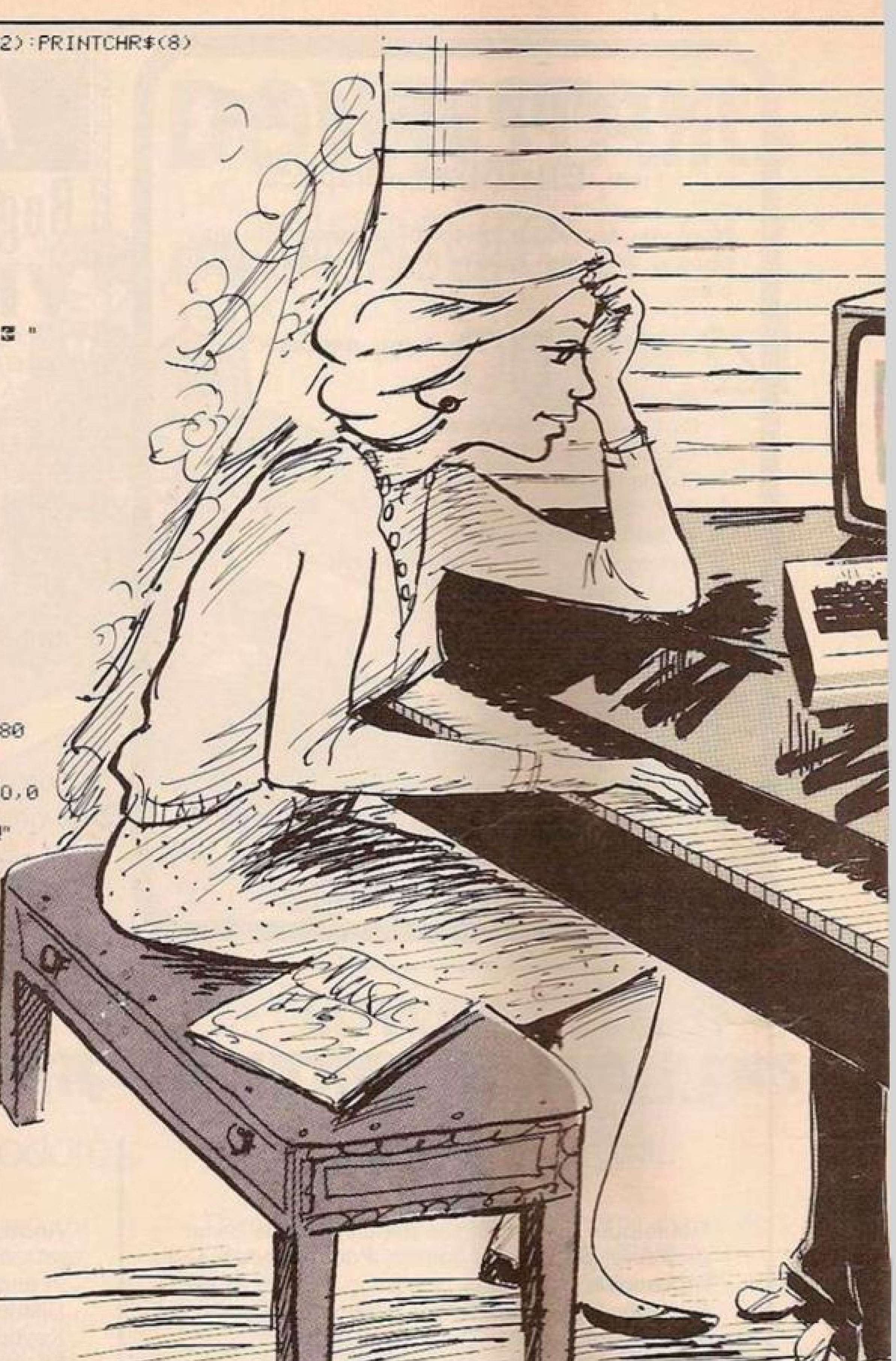
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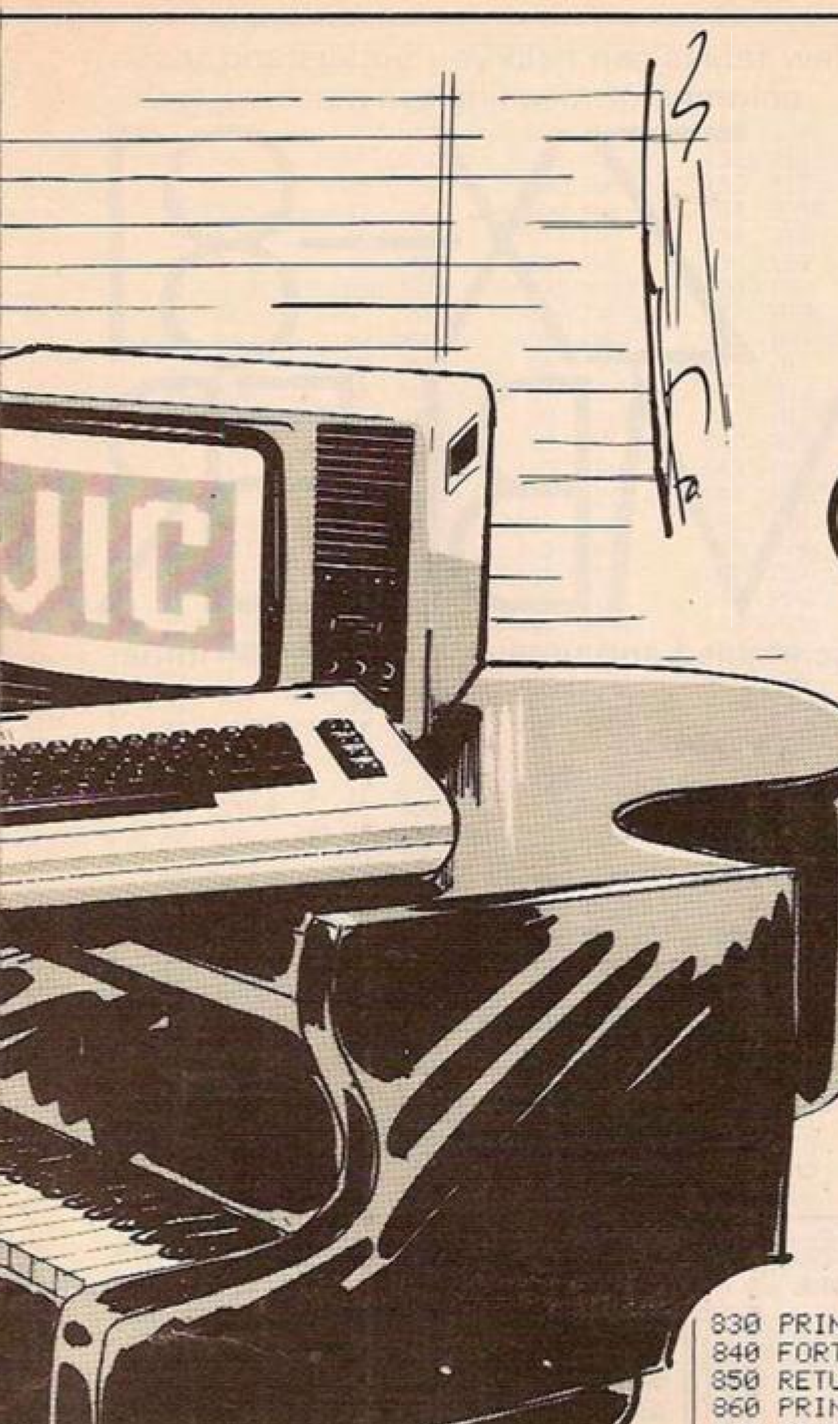
```
0 POKE 37150,3:POKE 788,194:PRINTCHR$(142):PRINTCHR$(8)
1 REM ********************
2 REM * SIMON CHALLENGE *
3 REM * BY D.REICHENTAL *
4 REM ********************
10 CX=36879:D=16:VO=36875
20 POKE CX,8:POKE 36878,15
30 DIM N%(40):PRINT"▒"
40 C$(1)="▒▒          "
50 R$="▒▒▒▒▒▒▒"
60 C$(2)="▒▒          "
70 C$(3)="▒▒          "
80 C$(4)="▒▒          "
90 S$="▒▒▒▒▒▒▒▒▒▒▒▒▒"
100 LO$="      ▒ ▒ ▒ ▒ ▒ ▒ ▒ ▒ ▒ ▒ ▒ ▒ ▒ ▒ "
110 P$="▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒"
120 GOSUB860:GOSUB 500
130 PRINT"▒▒LEVEL";LE
140 FOR I=1 TO 9
150 PRINTC$(1);
160 PRINTTAB(12)C$(2)
170 NEXT
180 PRINT"▒▒"
190 FOR I=1 TO 9
200 PRINTC$(3);
210 PRINTTAB(12)C$(4)
220 NEXT
230 GOSUB 730
240 GOSUB 550
250 FOR TD=1 TO 200:NEXT
260 FOR C=1 TO L
270 POKE 198,0
280 GET K$:IF K$="" THEN 280
290 IF ASC(K$)<133 OR ASC(K$)>136 THEN 280
300 ON ASC(K$)-132 GOSUB380,410,440,470
310 GOSUB 680
320 FOR TD=1TO 200:NEXT:POKE CX,8:POKE VO,0
330 PRINTR$TAB(4)"▒▒ "TAB(16)"▒▒ ▒"
340 PRINT"▒▒"P$TAB(4)"▒▒▒ ▒"TAB(16)"▒▒ ▒"
350 NEXT
360 FOR TD=1 TO 1000:NEXT
370 GOTO 240
380 POKE VO,204
390 PRINTR$TAB(4)"1"
400 RETURN
410 POKE VO,208
420 PRINTR$TAB(16)"2"
430 RETURN
440 POKE VO,212
450 PRINT"▒▒"P$TAB(4)"▒3"
460 RETURN
470 POKE VO,216
480 PRINT"▒▒"P$TAB(16)"▒4"
490 RETURN
500 FOR NO=1 TO 40
510 F%=(RND(1)*4)+1
520 N%(NO)=F%*4
530 NEXT
540 RETURN
550 L=L+1
560 FOR S=1 TO L
570 POKE VO,200+N%(S)
580 ON N%(S)/4 GOSUB 380,410,440,470
590 FOR TD=1 TO 10000/(10↑LE):NEXT
600 PRINTR$TAB(4)"▒▒ ▒"TAB(16)"▒▒ ▒"
610 PRINT"▒▒"P$TAB(4)"▒▒▒ ▒"TAB(16)"▒▒ ▒"
620 POKE VO,0
630 NEXT
640 IFL=12ORL=24THENLE=LE+1:PRINT"▒▒"P$"TTTTT▒IT'S GETTING HARDER":FORTD=1TO100
:NEXT
650 PRINT"▒▒"P$"TTTTT           SIMON          "
660 IFLE>3 THEN LE=1
670 RETURN
680 IF PEEK(VO)=(N%(C)+200)THEN RETURN
690 POKE CX,42:POKE VO,150
700 PRINT"▒"TAB(9)"▒▒W▒▒R▒▒O▒▒N▒▒G"
710 FOR TD=1 TO 1500:NEXT
720 GOTO 1130
730 FOR Q=0 TO 8
740 PRINTS$TAB(Q)"SIMON"
750 PRINTS$TAB(D)"SIMON"
760 POKE VO-1,250-D
770 FOR TD=1 TO 150:NEXT
780 POKEVO-1,0
790 PRINTS$TAB(Q)"     "
800 PRINTS$TAB(D)"     "
810 D=D-1
820 NEXT
```



SIMON CHALLENGE was written for a standard Vic-20 and makes full use of colour and sound. There are three levels of play and provision to obtain 40 notes.

Line 0 disables the Restore key, Runstop key, switches to upper-case mode and freezes it there. In line 10 Cx means colour and Vo signifies sound.

Lines 40, 60, 70 and 80 are the square colours while lines 140-220 print squares. The keyboard buffer is cleared by line 270. Lines 280-300 get notes from the keyboard. Lines



GAMES

SIMON CHALLENGE

Simon Challenge is a fun way of learning musical notes which exploits the audio-visual capability of the Vic-20. David Reichental's program presents four colours on the screen. Numbers in white boxes flash up on the screen and simultaneously a note sounds. You have to repeat the note or series of notes correctly to score full marks.

500-530 loop for random notes, while 640 increases note speed and puts you up one level. Line 680 checks note.

It is advisable to save the program before running it or equally you can take out line 0.

```
830 PRINTS$TAB(Q-1)"SIMON"
840 FORTD=1TO1500:NEXT
850 RETURN
860 PRINT"╗"
870 PRINT"■■■■■■■■■■■■■■■■■SIMON■               A GAME OF CHALLENGE"
880 PRINT"■  INSTRUCTIONS(Y/N)"
890 GETZ$:IF Z$=""THEN890
900 IFZ$<>"N"ANDZ$<>"Y"THEN 890
910 IF Z$="N" THENPRINT"╗":GOTO 1030
920 PRINT"╗"
930 PRINT LO$
940 PRINT"■■       INSTUCTIONS"
950 PRINTLO$
960 PRINT"■■ IN THIS GAME YOU MUST MEMORISE";
970 PRINT" A SEQUENCE   OF NOTES AND PLAY      THEM BACK TO SIMON"
980 PRINT"■■ USEING KEYS:"
990 PRINT"■ F1=1,F3=2"
1000 PRINT"■ F5=3,F7=4"
1010 PRINT"■■■■■PRESS ANY KEY■"
1020 GETZ$:IFZ$=""THEN1020
1030 PRINT"╗"
1040 PRINT"■LEVELS;"
1050 PRINT"■■■1■ ■EASY"
1060 PRINT"■■■2■ ■HARD"
1070 PRINT"■■■3■ ■DIFFICULT"
1080 GET N$:IF N$="" THEN 1080
1090 LE=VAL(N$)
1100 IF LE<1 OR LE>3 THEN 1080
1110 PRINT"╗"
1120 RETURN
1130 PRINT"╗"
1140 POKE VO,0
1150 POKECX,8
1160 PRINT"■■■■■SIMON SAYS"
1170 PRINT"■■■AT LEVEL";LE
1180 PRINT"■■■YOU SCORED";(L*10/2)+LE
1190 PRINT"■■■■■■■■DO YOU WANT TO PLAY ■■■■■■AGAIN(Y/N)"
1200 GETZ$:IFZ$=""THEN1200
1210 IFZ$<>"N"ANDZ$<>"Y"THEN 1200
1220 IF Z$="Y" THEN CLR:GOTO 10
1230 PRINT"╗■":POKE CX,27
```

Figure 1. **On ZX-81. Typical output.**

Sinclair character	Address content	Address	Z80	Mnemonic		
E	42	3379	LD	HL	(16432)	
K	48	3380				
RND	64	3381				
?	78	3382	LD	C	HL ←	(Inverse HL)
7	35	3383	INC	HL		
?	70	3384	LD	B	HL ←	
FOR	235	3385	EXX	DE	HL	

A few tables can help you understand those columns of meaningless machine code.

ZX-81 DISASSEMBLER

Unscrambled and unravelled by David Horne.

Figure 4. **Tables**

```
   1 REM W001BD18E2802J03J01JL+0
9XCCE981E63802K03K01KL-00405IAC1
7E2A02M03M01ML*00J05E9A1E73A021
3I01IL,00JN5190IU9290?F03F01FL/0
0J05E991 9U390200300 1GLZ00JP81M01
UE2M0260360I0L,00J05E9MIEU3M02E0
3E01EL.001JJ1JK1JM1JI1JF1JG1J61J
EIKJ1KK1KM1KI1KF1KG1K61KE1MJ1MKJ
MM1MI1MF1MG1M61ME1IJ1IK1IM1II1I
1IG1I61IE1FJ1FK1FM1FI1FF1FG1F61F
E1GJ1GK1GM1GI1GF1GG1G61GE16J16K1
6M16I16F16G50016E1EJ1EK1EM1EI1EF
[illegible]
TD=000TDMC0KL0C00NU01M9IUDY000UD
030HL0000
   2 REM RICARRCARIA DAA RRA SCF
  CCF DI   LD INC DEC DJNZHALTRST
0RST8RS16RS24RS32RS40RS48RS56ADD
 AND CALL CP  JP  JR  OR POP PUS
HRET SBC SUB XOR ADC SBC  IN OUT
 EXX NOP  EX  EI CPL
   3 REM [illegible]LDED
CAFNNA H L D E B C N SPNZZ NCC P
00S+ - [illegible]PE
   4 REM 03430522053205430702070
20862009421022110211221132114211
21162117211921262134214221502156
2166217421622190220 33
```

Function

- Pointer table — blocks of three
- Command table — blocks of four
- Extension table — blocks of two
- ED, CB, IX, IY Table — blocks of four

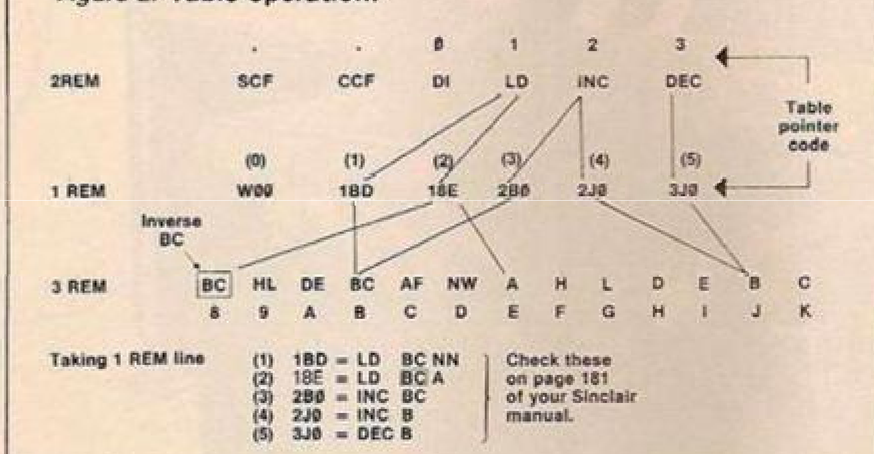


Figure 2. **Table operation.**

Figure 5. **Basic listing.**

```
   6 LET G=17540        — ED CB IX IY table start   G
   7 LET A=16514        — Pointer table start       A
   8 LET N=17286        — Command table start       N
   9 LET P=17466        — Extension table start     P
  10 LET C=28
  11 LET D=C/C
  12 LET E=D+D
  13 FOR J=D-D TO A     — The address limits of code to
  14 PRINT AT 7,D-D;CHR$ PEEK J;    be disassembled
TAB 7;PEEK J;TAB 10;"▌";J;TAB 16
;"▌";
  15 LET I=A+3*PEEK J   — 1st item
  16 LET K=PEEK I       — 2nd item   Pointer
  17 LET L=PEEK (I+D)   — 3rd item   table
  18 LET M=PEEK (I+E)
  19 LET F=J
  20 IF L=C+E+D THEN GOTO 90   — Test for DD FD
  21 IF L=C+E+E THEN GOTO E*C-D — Test for ED
  22 IF L=C+E THEN GOTO 50     — Test for CB
  24 LET I=N+((K-21)*E*E)
  25 PRINT CHR$ PEEK I;CHR$ PEEK  — Print the command
(I+D);CHR$ PEEK (I+E);CHR$ PEEK
(I+D+E);" ";
  26 IF L=49 THEN GOTO 42     — Test for single number
  27 IF L=60 THEN GOTO C+C+C  — Test for double number indirect
  29 LET I=P+((L-C)*E)
  30 GOSUB 80
  31 IF M=49 THEN GOTO 63     — Test for single number
  32 IF M=41 THEN GOTO 67     — Test for double number direct
  33 IF M=60 THEN GOTO 71     — Test for double number indirect
  34 IF M=C+C THEN GOTO G-P   — Test for displacement
  36 LET I=P+((M-C)*E)
  37 GOSUB 80
  38 PRINT
  39 SCROLL
  40 IF J>F THEN GOTO G+C-P
  41 NEXT J
  42 PRINT PEEK (J+D);" ";    — Print the single number
  43 LET J=J+D
  44 GOTO 36
  46 PRINT "(";PEEK (J+D)+256*PE — Print the double number
EK (J+E);")";                     indirect
  47 LET J=J+E
  48 RETURN
  50 LET J=J+D      — CB routine
  51 GOTO C
  55 LET B=D        — ED routine
  56 FOR I=D-D TO C+C STEP 8
  57 IF PEEK (J+D)=67+I THEN LET
B=D+E
  58 NEXT I
  59 LET J=J+B
  60 GOTO C
  63 PRINT PEEK (J+D);       — Print single number
  64 LET J=J+D
  65 GOTO 36
  67 PRINT PEEK (J+D)+256*PEEK ( — Print the double number direct
J+E);
  68 LET J=J+E
  69 GOTO 36
  71 GOSUB 46
  72 GOTO 36
  74 IF PEEK (J+D)>126 THEN GOTO
 77
  75 PRINT PEEK (J+D);
  76 GOTO 64
  77 PRINT (PEEK (J+D))-256;
  78 GOTO 64
  80 PRINT CHR$ PEEK I;CHR$ PEEK — Print extension
(I+D);" ";
  81 RETURN
  84 GOSUB G-P-C     — Gosub 46
  85 GOTO C+D+E
  90 LET B=D         — DD FD routine
  91 FOR H=G TO G+106 STEP E+E
  92 IF PEEK (J+D)=(((PEEK H)-C)
*100+(PEEK (H+D)-C)*10+(PEEK (H+
E)-C)) THEN LET B=PEEK (H+D+E)-C
  93 NEXT H
  94 GOTO 59
 102 PRINT AT 7,D-D;CHR$ PEEK (F
+D);TAB 7;PEEK (F+D);TAB 10;"▌"
F+D,"▌"
 103 LET F=F+D
 104 GOTO 39
```

Figure 7. Command table. REM 2.

1	RICA	+
2	RRCA	—
3	RIA	*
4	DAA	/
5	RRA	;
6	SCF	,
7	CCF	.
8	DI	0
9	LD	1
10	INC	2
11	DEC	3
12	DJNZ	4
13	HALT	5
14	RST0	6
15	RST8	7
16	RS16	8
17	RS24	9
18	RS32	A
19	RS40	B
20	RS48	C
21	RS56	D
22	ADD	E
23	AND	F
24	CALL	G
25	CP	H
26	JP	I
27	JR	J
28	OR	K
29	POP	L
30	PUSH	M
31	RET	N
32	SBC	O
33	SUB	P
34	XOR	Q
35	ADC	R
36	SBC	S
37	IN	T
38	OUT	U
39	EXX	V
40	NOP	W
41	EX	X
42	EI	Y
43	CPL	Z

MOST OF THE Z-80 op code consists of a little over 40 commands, such as ld, inc, add and push as well as just over 30 extensions to the commands like a, sp and nz. Therefore, a block of machine code can be disassembled with the aid of a few tables.

Manual disassembly

Appropriate spaces have been left for manual disassembly of IX, IY, CB or ED codes. Where a machine-code routine contains a character set of a table of displacements, these will also be disassembled. Hence disassembled listings will also display either the Sinclair or ASCII character and the address content as shown in figure 1.

The first table has 256 blocks of data to act as pointers to the second and third tables which provide the mnemonics of the assembly language. The first part of the block should point to a position in the command table, the second and third parts to a position in the extensions table, that is:

ld (command) b (1st extension) c (2nd extension) = ld b,c

Sometimes there is no extension and in other cases one, see figure 2. The program will work on a ZX-81 with a minimum of 3K memory. Your initial task is to produce the Rem statements in figure 4. The first Rem contains 768 bytes — you will not have to tap them all in. Enter fast mode and type in 100 characters. It is easier if you type in numerals, see figure 3.

Line editing

Edit line 1 and change the line number to 2. Edit line 2 and change the line number to 3.

Figure 6. Pointer table. REM 1.

0	W00	43	390	86	1H6	129	EEK	172	QF0	215	800
1	1BD	44	2G0	87	1HE	130	EEH	173	QG0	216	NQ0
2	18E	45	3G0	88	1IJ	131	EEI	174	Q60	217	V00
3	2B0	46	1GL	89	1IK	132	EEF	175	QE0	218	IQD
4	2J0	47	Z00	90	1IH	133	EEG	176	KJ0	219	TEL
5	3J0	48	JPS	91	1II	134	EE6	177	KK0	220	GQD
6	1JL	49	1MD	92	1IF	135	EEE	178	KH0	221	030
7	+00	50	1WE	93	1IG	136	REJ	179	KI0	222	OEL
8	XCC	51	2M0	94	1I6	137	REK	180	KF0	223	900
9	E9B	52	260	95	1IE	138	REH	181	KG0	224	NR0
10	1E8	53	360	96	1FJ	139	REI	182	K60	225	L90
11	3B0	54	16L	97	1FK	140	REF	183	KE0	226	IRD
12	2K0	55	,00	98	1FH	141	REG	184	HJ0	227	XV9
13	3K0	56	JQS	99	1FI	142	RE6	185	HK0	228	GRD
14	1KL	57	E9M	100	1FF	143	REE	186	HH0	229	M90
15	-00	58	1EW	101	1FG	144	PJ0	187	HI0	230	FL0
16	40S	59	3M0	102	1F6	145	PK0	188	HF0	231	A00
17	1AD	60	2E0	103	1FE	146	PH0	189	HG0	232	NX0
18	17E	61	3E0	104	1GJ	147	PI0	190	H60	233	I60
19	2A0	62	1EL	105	1GK	148	PF0	191	HE0	234	IXD
20	2H0	63	.00	106	1GH	149	PG0	192	NN0	235	VA9
21	3H0	64	1JJ	107	1GI	150	P60	193	LB0	236	GXD
22	1HL	65	1JK	108	1GF	151	PE0	194	IND	237	040
23	*00	66	1JH	109	1GG	152	SEJ	195	I0D	238	QL0
24	J0S	67	1JI	110	1G6	153	SEK	196	GND	239	B00
25	E9A	68	1JF	111	1GE	154	SEH	197	MB0	240	NT0
26	1E7	69	1JG	112	16J	155	SEI	198	EEL	241	LC0
27	3A0	70	1J6	113	16K	156	SEF	199	600	242	ITD
28	2I0	71	1JE	114	16H	157	SEG	200	N0O	243	=00
29	3I0	72	1KJ	115	16I	158	SE6	201	N00	244	GTD
30	1IL	73	1KK	116	16F	159	SEE	202	IOD	245	MC0
31	;00	74	1KH	117	16G	160	FJ0	203	020	246	KL0
32	JNS	75	1KI	118	500	161	FK0	204	GOD	247	C00
33	19D	76	1KF	119	16E	162	FH0	205	G0D	248	NU0
34	1W9	77	1KG	120	1EJ	163	FI0	206	REL	249	1M9
35	290	78	1K6	121	1EK	164	FF0	207	700	250	IUD
36	2F0	79	1KE	122	1EH	165	FG0	208	NP0	251	Y00
37	3F0	80	1HJ	123	1EI	166	F60	209	LA0	252	GUD
38	1FL	81	1HK	124	1EF	167	FE0	210	IPD	253	030
39	/00	82	1HH	125	1EG	168	QJ0	211	ULE	254	HL0
40	JOS	83	1HI	126	1E6	169	QK0	212	GPD	255	D00
41	E99	84	1HF	127	1EE	170	QH0	213	MA0		
42	19W	85	1HG	128	EEJ	171	QI0	214	POL		

Data in blocks of three.

Figure 3.

```
   1 REM 12345678901234567890123
45678901234567890123456789012345
67890123456789012345678901234567
8901234567890
```

Figure 9. Extension table. REM 3.

1		0
2		1
3	[CB]	2) Inverse characters
4	[IX]	3)
5	[ED]	4)
6	[IY]	5)
7	[HL]	6)
8	[DE]	7)
9	[BC]	8)
10	HL	9
11	DE	A
12	BC	B
13	AF	C
14	NN	D
15	A	E
16	H	F
17	L	G
18	D	H
19	E	I
20	B	J
21	C	K
22	N	L
23	SP	M
24	NZ	N
25	Z	O
26	NC	P
27	C	Q
28	PO	R
29	DS	S
30	+	T
31	—	U
32	[SP]	V) Inverse characters
33	[NN]	W)
34	PE	X

Data in blocks of two.

Continue until you have produced Rems 1 to 7. Then type:

8 REM 123 . . . . 3456 (26 characters)

Save the code so far produced by Save "1". To check, type:

PRINT PEEK 17282, PEEK 17283

This should give two answers, both 118. Anything else is an error. Look for patterns in the Rem statements to help find the error.

Type in the following for one long Rem statement.

```
POKE 16511, 2
POKE 16512, 3
```

Then type

```
2 Slow,
3 Fast,
LIST
POKE 16510,0 (prevents you from editing this line)
```

and

```
SAVE "2"
```

Next enter the data loader. Type:

```
2 For A = 16514 to 17281
3 Scroll
4 Input B$
5 Poke A, Code B$
6 Print A; TAB B; Peek A, CHR$ PEEK A
7 Next A
```

You will probably think initially that the first few lines have not entered because the cursor will show in your Rem statement, but do not worry.

Note your errors

Carefully enter the Data in the Rem statement by typing Run. Make a note of any errors you make and go over them later on by Poking the correct value. The complete list is given in figure 6. Be careful about ls and Is, 0/O, B/8, 6/G and 5/S. It is easy to type in the wrong one. Compare your Rem line with that of figure 4 and correct as follows: Poke address, Code "*" — where address is the position of the error and * the correct value. That is:

POKE 16514, Code "W"

Figure 8. Bytes table REM 4

Number of ports to Z-80 op code

CB	IX IY		ED
All 1's	All 1's EXCEPT		All 1's
	034	3	
	052	2	
	053	2	
	054	3	
	070	2	
	078	2	
	086	2	
	094	2	
	102	2	
	110	2	
	112	2	
	113	2	
	114	2	
	115	2	
	116	2	
	117	2	
	119	2	
	126	2	
	134	2	
	142	2	
	150	2	
	158	2	
	166	2	
	174	2	
	182	2	
	190	2	
	203	3	

The above takes into account the important Z-80 op codes to these parameters.

You may save a partially completed Rem statement, erase the quotation marks and enter Stop.

After line 2 you can carry on from where you left off, then Save "3". When you have completed the data entry into the first Rem Save "4". Enter Rems 2, 3 and 4 — figure 4 — as you would a normal Rem statement. The spaces are important, see figures 6, 7, 8 and 9.

Table check

The following will check whether your tables are correct. I assume Print Peek 16514 will give 60. Print Peek 17288 should give 55 — if not the first table length is wrong. Print Peek 17470 should give 168; anything else indicates the length of table 2 is wrong. Check the space after CPL, remembering it is in blocks of four. Print Peek 17540 should give 28 — an error showing table 3 is wrong.

When correct, delete line 5 and enter the program in figure 4. If your memory is more than 3K, change Print At 7 to Print At 20 in lines 14 and 102.

If you wish to try the program on the Spectrum, you will have to amend lines 14 and 102 as above. There is also no scroll facility, and it may work without line 39. Lastly the long Rem statement may work, but it is also possible that because the program is now sitting at the top of the memory map, you may well be able to enter the code directly.

Use printer listings as the Bible. If you have neither patience nor time, a small number of cassettes containing this ZX-81 disassembler can be obtained by post for £3 from: D R Horne, 126 Southridge Rise, Crowborough, East Sussex. ■

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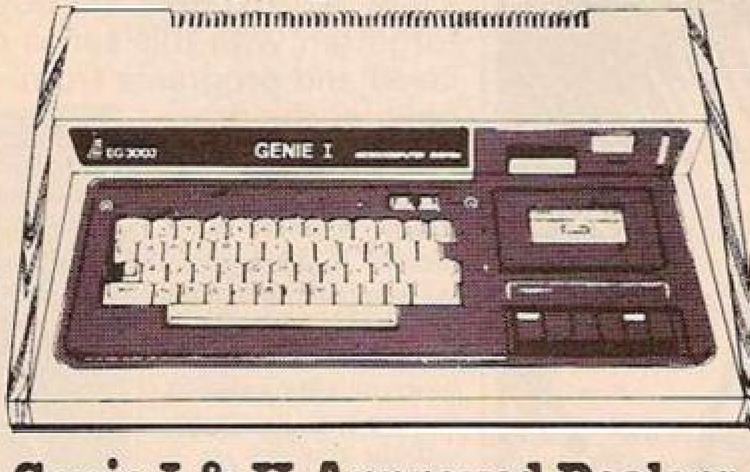
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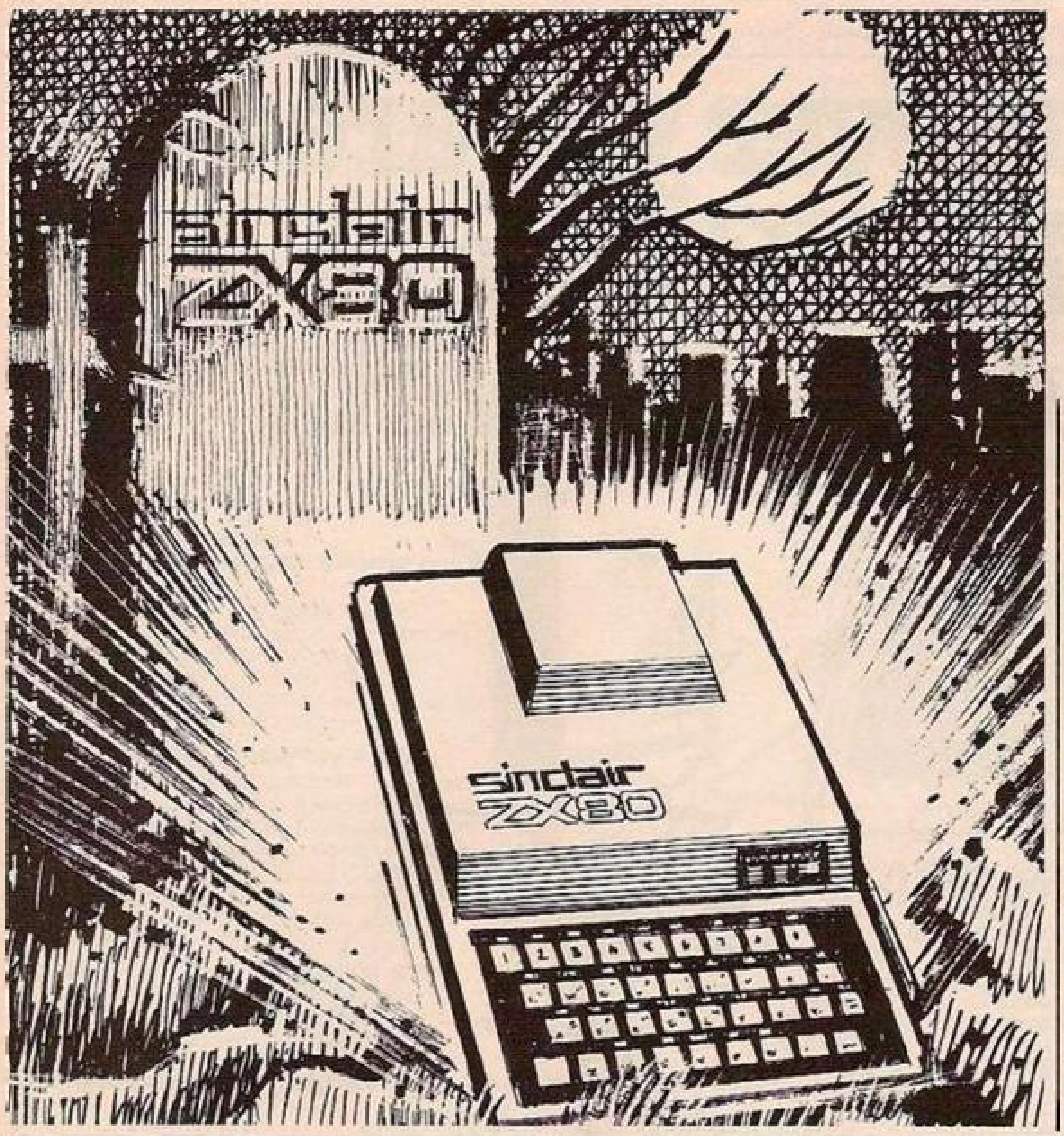
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ZX-80 FROM

Paul Hutchinson shows that ZX-80 old-ROMers are not forgotten with this series of ideas and programs from beyond the grave.

ENTERING MACHINE-CODE routines into your ZX-80, with 4K ROM, is always a tedious process. If you have a 16K RAM you could put several of these routines into one program and save it on a cassette. This program can then be Loaded at the start of each subsequent program-writing session saving a great deal of frustration.

If the routines are suitably protected and you have a record of the start addresses for each of the subroutines you can use them quite easily with the USR function.

Pause, Inkey$ and Scroll are useful functions, which are not available directly from the old-ROM ZX-80 keyboard. These are implemented by the hexadecimal machine-code listing in program 2. The machine-code listing is 188 bytes long, each byte containing

Program 3.

```
10 LET AD=PEEK(16392)+256*PEEK(16393)-188
20 RANDOMISE
30 LET M=0
40 LET C=0
50 LET S=0
60 LET P=0
100 FOR A=1 TO 22
110 PRINT "@@@@@@@@",,"@@@@@@@@"
120 NEXT A
200 LET DF=PEEK(16396)+256*PEEK(16397)
210 LET Y=DF+M+49
215 FOR K=0 TO 100
220 LET Q=RND(15)
230 LET I=RND(15)
240 LET U=RND(15)
250 LET G=RND(15)
260 LET X=USR(AD)
400 LET Z=USR(AD+171)
404 PRINT "@@@@@@@@",,"@@@@@@@@"
407 IF K>79 THEN GOTO 420
410 IF PEEK(DF+Q+669)=0 THEN POKE DF+Q+669,20
412 IF K>5 THEN POKE DF+I+669,20
414 IF K>10 THEN POKE DF+G+669,20
416 IF K>25 THEN POKE DF+U+669,20
420 LET DF=PEEK(16396)+256*PEEK(16397)
425 LET M=0
430 IF CHR$(USR(AD+130))="0" THEN LET M=1
435 IF CHR$(USR(AD+130))="1" THEN LET M=-1
437 IF PEEK(Y+1)=9 AND M=1 THEN LET M=0
438 IF PEEK(Y-1)=9 AND M=-1 THEN LET M=0
440 LET Y=Y+M
443 IF CHR$(USR(AD+130))="P" THEN GOSUB 810
445 IF PEEK(Y)=20 THEN LET C=C+1
447 IF PEEK(Y)=20 THEN GOSUB 1000
450 POKE Y,3
500 NEXT K
550 CLS
600 PRINT"YOUR TIME IS UP."
610 PRINT"YOU HAD ";C;" COLLISIONS"
612 PRINT"AND ";S;" SHOTS ON TARGET"
620 IF C>0 AND C<9 THEN PRINT"NOT BAD BUT
    SHIP DAMAGED"
625 IF C>8 AND C<20 AND S>35 THEN PRINT"GOOD
    SHOOTING BUT SHIP IS BADLY DAMAGED"
630 IF C=0 AND S>40 THEN PRINT"EXCELLENT"
634 IF C>19 THEN PRINT "YOUR SHIP NEEDS
    REBUILDING"
636 IF S<35 THEN PRINT"INVADERS HAVE TAKEN
    YOUR BASE"
640 INPUT A$
645 CLS
800 STOP
810 IF P=0 THEN LET Y=Y+4
815 LET P=P+1
820 FOR Z=1 TO RND(15)
830 IF PEEK(Y+Z*33)=20 THEN GOSUB 900
850 NEXT Z
860 RETURN
900 POKE Y+Z*33,0
905 LET S=S+1
910 LET Z=15
915 GOSUB 1100
920 RETURN
1000 POKE DF+3,40
1010 POKE DF+4,55
1020 POKE DF+5,38
1030 POKE DF+6,56
1040 POKE DF+7,45
1050 RETURN
1100 POKE DF+26,45
1110 POKE DF+27,46
1120 POKE DF+28,57
1130 RETURN
```

BEYOND THE GRAVE

two hexadecimal digits, and will take time to insert — but should prove worthwhile.

This program gives protection and a limited editing capability which is useful for loading long routines. Enter the listing two digits at a time. After every tenth entry you can alter mistakes before continuing. A full listing is produced for a final check. I suggest that you Save the hexadecimal loader on cassette before entering the listing so that it can be used for other collections of useful routines if necessary.

Once the listing is correctly entered you can delete all of the lines except line 10. Before Saving the listing add a few Rem lines to give a record of the routine start addresses. E.g.,

```
1000 REM LET Z=USR(AD) WILL CALL THE
     PAUSE ROUTINE
1010 REM CHRS(USR(AD + 130)) SIMULATES
     INKEY$
1020 REM LET X=USR(AD + 171) CALLS THE
     SCROLL ROUTINE
```

When you Load the program at a later date the start addresses are there for your convenience and the Rem lines can be deleted if you wish when you compose your games program.

The array in line 1 is a dummy into which the routine is placed. Since the array starts with the element A(0) and each element consists of two bytes, the required array size is NB/2 -1 where NB is the number of bytes of machine code to be entered. In the listing NB=188 so we need Dim(93).

The routine is protected by the execution of lines 2 and 3 which, after line 1 has reserved the first 188 bytes of variables, move the Vars pointer from its normal position at the start of the variables to the location of E-Line at the end of the variables, as shown in the ZX-80 operating manual. Since the array has been incorporated into the program area of the RAM the ZX-80 no longer treats it as a variable. Consequently the Run and Clear commands can be used in future without deleting the machine code. Line 10 gives the address of the first byte of the routine, i.e., Vars — NB and should be retained.

The Pause routine occupies the first 130 bytes, from AD+0 to AD+129. This routine also scans the numerical keys and returns the appropriate value. It is consequently much more than a simple pause as it can be used in a similar way to an Inkey$ routine. Whenever Usr(AD) appears in your program, however, a pause is automatically executed. The duration of the pause can be altered by Poking (AD+21).

Once you have entered the listing and removed the loader try the following short program:

```
10 LET AD = PEEK(16392) + 256*PEEK(16393)
   — 188
20 FOR X = 1 TO 20
30 POKE AD + 21,25*X
60 PRINT USR(AD)
100 NEXT X
```

Line 30 alters the length of the pause; note how it increases as the value Poked rises towards 255 and then returns to a low value before lengthening again. If a numerical key is depressed during execution, line 60 prints its value, otherwise -1 is printed. Play with this depressing different keys and combinations of keys to see how it responds.

If you now alter line 60 to:

```
60 IF USR(AD) = -1 THEN PRINT X
```

it should print X unless you press a numerical key. Now try adding these lines:

```
50 LET A = USR(AD)
60 IF A = -1 THEN LET
   X = X-1
70 PRINT X
```

Games programs become much easier. Try:

```
10 as above
20 FOR X = 1 TO 20
50 LET A = USR(AD)
60 PRINT X,CHRS(USR(AD + 130))
70 IF USR(AD + 130) = 63 THEN STOP
100 NEXT X
```

Provided a key is held down when the screen blinks, line 60 will print the corresponding character. Line 70 also uses the Inkey$ routine

(continued on next page)

```
1 DIM A(93)
2 POKE 16392,PEEK(16394)-1
3 POKE 16393,PEEK(16395)+(PEEK(16394)=0)
10 LET AD=PEEK(16392)+256*PEEK(16393)-188
20 FOR I=AD TO PEEK(16392)+256*PEEK(16393)-1
25 PRINT I
30 INPUT A$
40 PRINT A$
45 POKE I,16*CODE(A$)+CODE(TL$(A$))-476
50 IF PEEK(16421)<15 THEN GOSUB 500
55 NEXT I
60 PRINT
65 PRINT
70 PRINT"IS IT ALL CORRECT? Y OR N"
80 INPUT A$
90 IF NOT A$=Y THEN GOSUB 1000
100 IF NOT A$="Y" THEN GOTO 70
190 CLS
200 FOR I=AD TO AD+187
210 LET B=PEEK(I)
220 PRINT I,CHR$(B/16+28);CHR$(B-(B/16)*16+28),
230 NEXT I
240 STOP
500 PRINT
505 PRINT"CHECK SO FAR. N/L TO CONTINUE, C TO
    MAKE CORRECTION"
510 INPUT A$
520 IF A$="C" THEN GOSUB 1000
530 IF A$="C" THEN GOTO 505
535 CLS
540 RETURN
1000 PRINT
1010 PRINT"INPUT ADDRESS TO BE CORRECTED, N/L,
     VALUE, N/L"
1015 PRINT
1020 INPUT Z
1030 INPUT B$
1040 PRINT
1050 POKE Z,16*CODE(B$)+CODE(TL$(B$))-476
1060 PRINT Z;" CORRECTED"
1070 RETURN
```

Program 1.

(continued from previous page)
and checks for the input of the character whose code is 63, i.e., the Z key. Inputting Z will terminate the program. Try depressing two keys together; you will see that only one responds and that some have higher priority than others. For example, holding a 1 and a 0 always prints the 1, while depressing a 1 and a Z always prints the Z. This too could be useful in games.

The final routine at AD+171 to AD+187 is a screen Scroll. To see how it works change line 70 to:

```
70 IF USR(AD+130)=63 THEN LET J=USR
   (AD+171)
```

Now when Z is held a single line, scroll is executed. If line 70 is repeated as line 80 two lines are scrolled.

The Invaders game illustrates how you can use these routines. The program creates invaders, *, at the bottom of the screen and moves them upwards towards your ship, the shift W graphic, after each pause. You can move the ship right or left using the 0 and 1 keys. To fire at an invader directly below your ship use the P key.

Your gun has a maximum range of 15 lines and uses a random number, so close invaders are usually easily hit but distant invaders are often missed. Note: @ represents shift A. Some variables are:

DF is the start location of the display file
C records the number of collisions
S records the number of shots on target
Y is the position of your ship in the display file

The next program uses the Pause to flash some "curious characters" on to the screen. The Poking in lines 20 to 50 and 120 load the interrupt register with a series of values from 0 to 46. Line 110 prints the "curious character" and the subroutine at 500 to 570 produces an enlarged version on an eight-by-eight matrix.

```
AD+0    E5 2A 10 40 ED 4B 24 40 04 AF
AD+10   B9 3E 76 28 02 77 23 10 FC 11
AD+20   FF 32 26 BF 01 FE F7 ED 78 F6
AD+30   E0 6F 2F FE 01 9F B4 A5 A3 5F
AD+40   CB 00 CB 04 38 ED 41 ED 78 17
AD+50   17 9F E6 18 C6 20 32 23 40 D9
AD+60   06 2A 10 FE 3E 0F D3 FF 3E EC
AD+70   06 19 2A 0C 40 CB FC CD AD 01
AD+80   3E F3 04 2B FD 35 23 18 00 CD
AD+90   AD 01 06 1D 00 00 10 FC 30 D9
AD+100  15 20 AF 7B 1E 78 E1 19 1E 0A
AD+110  BE 28 04 23 1D 20 F9 EB 2B C9
AD+120  7D 7B 77 6F AF B7 BB BD BE 7E
AD+130  01 FE FE 26 00 ED 78 1F 38 06
AD+140  2E 92 37 17 13 04 2E 6B ED 78
AD+150  F6 E0 E6 DF 2B 37 23 1F 38 FC
AD+160  3C 7E 20 05 CB 00 38 EC AF 6F
AD+170  C9 2A 0C 40 3E 76 23 ED B1 2B
AD+180  22 0C 40 21 25 40 34 C9
```

Program 2.

The large matrix is a repeat of the pattern produced by the single character, where individual black/white elements of the character are reproduced by a different patterned character in the enlarged version. If you wish to see this more clearly replace the Pause line with 160 Input A$ and use the newline to increment the values.

The interrupt register is normally loaded during initialisation with the decimal value 14 and the ZX-80 uses this in a mysterious way to address the character generator, which starts at the address 3584(d). By loading different numbers into this register the ZX-80 is fooled into using other areas of the ROM as the character generator; hence the characters.

The Pause is employed in a way which enables you to exit from program execution, returning the ZX-80 to its correct generator, by holding down the 0 key. To confuse family and friends you could use the Break key after a few characters have been produced. This will terminate the execution but leave an incorrect value in the interrupt register; consequently after depressing any other key the program listing returns in gibberish. Do not despair. The keyboard remains functional and if you hit the Run and Newline keys once more the program will execute once again. Try changing some of the lines to see if you can work out what is going on, e.g., try:

```
110 PRINT A
```

or

```
110 PRINT "A"
```

and

```
100 FOR A=0 TO 255
```

Also try 510 LET V=PEEK(3584+L+8*A)

If you only have 1K of RAM you can still produce flashing characters. The machine-code listing occupies only 188 bytes and you could store it on cassette. Enter the following short program to create the curious characters.

```
10 LET AD=PEEK(16392)+256*PEEK(16393)
   -188
20 POKE 17000,62
30 POKE 17002,237
40 POKE 17003,71
50 POKE 17004,201
100 FOR A=0 TO 46
105 CLS
110 PRINT CHR$(A)
120 POKE 17001,A
150 LET X=USR(17000)
160 LET B=USR(AD)
170 NEXT A
```

ZX-81 owners do not need line 10 and should use a suitable Pause in line 160. ■

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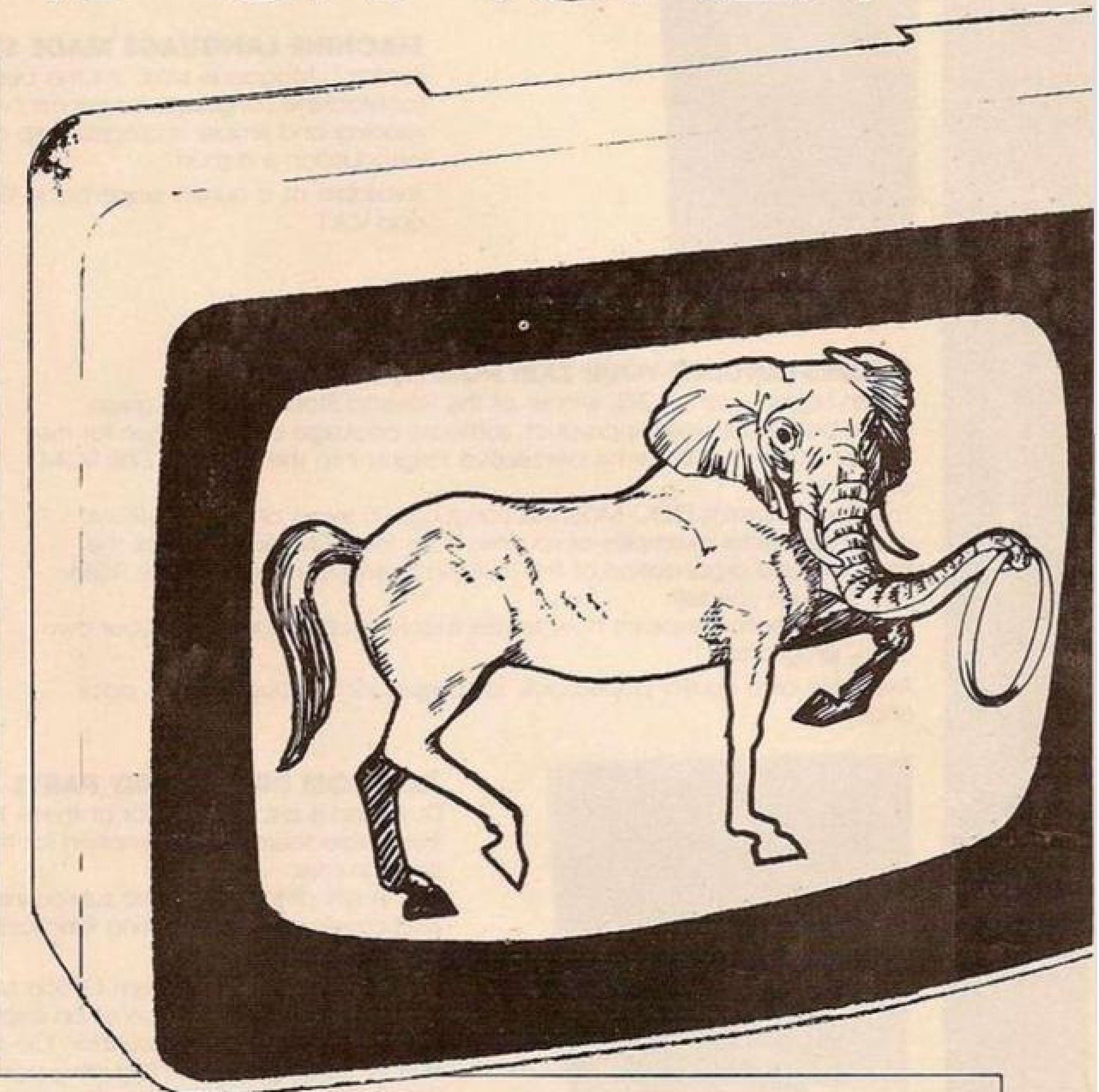
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QUIZ

ANIMAL CRACKER

Learning from its mistakes is how Richard Lancaster's Genie game in standard Basic guesses the name of the animal you have in mind.



THIS PROGRAM should interest and amuse both adults and children. Essentially this is a "think of an animal" game, although it could equally well be any other object. The computer tries to guess what you thought of, but what makes the game interesting is that the program learns from its mistakes. After each wrong guess it increases its knowledge. Figure 1 illustrates how this works in practice.

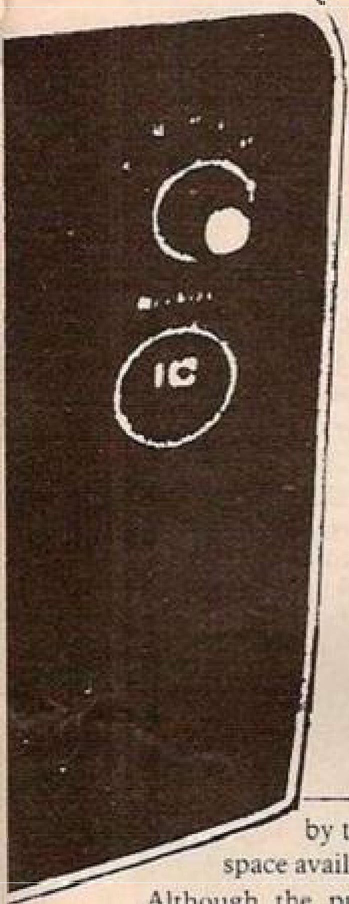
After every wrong guess the program asks what the answer was and also how it could distinguish between the new animal and the animals it already knows. In this way the program increases its knowledge and appears to learn from its mistakes.

The program starts out knowing only one animal, an elephant, but it adds to this after each try. The way this is achieved is to build up a Binary Decision Tree, a technique widely used in larger computers. The B-tree consists of a number of nodes — questions, and a number of leaves — animals. Each node or question has two pointers associated with it, a Yes pointer and a No pointer. Each of these will point to either another question or to an animal. This can be represented diagrammatically as in figure 2.

Every time a new animal is added a new question is also inserted and so the B-tree grows larger. The program is only restricted

```
10  CLEAR 7000
20  DEFINT Y,N:L=2:C=1:DEFSTR Q:DIM Q(250),Y(250),N(250):Q(1)=
    "AN ELEPHANT"
30  CLS:PRINT"GUESSING GAME (C) R H LANCASTER 1982"
40  PRINT:PRINT"ENTER SELECTION L - LOAD DATA FROM CASSETTE"
50  PRINTTAB(16)"S - SAVE DATA ON TO CASSETTE"
60  PRINTTAB(16)"I - INITIALISE PROGRAM"
65  PRINTTAB(16)"Q - QUIT GAME"
70  A$=INKEY$:IF A$="S" THEN 500 ELSE IF A$="L" THEN 600 ELSE IF
    A$="Q" THEN END ELSE IF A$<>"I" THEN 70
80  CLS:PRINT:"HAVE YOU THOUGHT OF AN ANIMAL ";A$
100 IF Y(C)=0 AND N(C)=0 THEN PRINT "IS IT ";Q(C);" ";:INPUT A$:ELSE
    GOTO 210
110 IF A$="" THEN 100 ELSE IF ASC(A$)=89 THEN PRINT"I GUESSED
    CORRECTLY":GOTO 240
120 IF ASC(A$)<>78 THEN 100
125 Q(L)=Q(C)
130 INPUT "WHAT WAS IT ";Q(L+1)
140 PRINT "WHAT QUESTION COULD I USE TO DISTINGUISH "
```

```
150 PRINT "BETWEEN ";Q(L);" AND ";Q(L+1):INPUT Q(C)
160 PRINT "WHAT WOULD THE ANSWER FOR ";Q(L+1);" BE";:INPUT A$
170 IF A$="Y" THEN Y(C)=L+1:N(C)=L
180 IF A$="N" THEN N(C)=L+1:Y(C)=L
190 L=L+2
200 GOTO 240
210 PRINT Q(C);:INPUT A$
220 IF A$="Y" THEN C=Y(C) ELSE IF A$="N" THEN C=N(C)
230 GOTO 100
240 INPUT"WOULD YOU LIKE TO TRY AGAIN ";A$:IF A$="Y" THEN CLS:C=1:GOTO
 80
250 CLS:GOTO 40
500 CLS:PRINT@650,"READY CASSETTE FOR SAVING DATA ";:INPUT A$
510 PRINT#-1,"GUESSING GAME DATA",L
520 J=INT(L/5)+1
530 FOR I=1 TO J:K=5*(I-1)+1
540 PRINT#-1,Q(K),Y(K),N(K),Q(K+1),Y(K+1),N(K+1),Q(K+2),Y(K+2),
N(K+2),Q(K+3),Y(K+3),N(K+3),Q(K+4),Y(K+4),N(K+4)
550 NEXT I
560 PRINT#-1,"END OF DATA"
570 CLS:GOTO 240
600 CLS
605 CLS:PRINT@650,"READY CASSETTE FOR READING DATA ";:INPUT A$
610 ON ERROR GOTO 700
620 INPUT#-1,A$,L
630 IF A$<>"GUESSING GAME DATA" THEN ERROR 22
640 J=INT(L/5)+1:FOR I=1 TO J:K=5*(I-1)+1
650 INPUT#-1,Q(K),Y(K),N(K),Q(K+1),Y(K+1),N(K+1),Q(K+2),Y(K+2),
    N(K+2),Q(K+3),Y(K+3),N(K+3),Q(K+4),Y(K+4),N(K+4)
660 NEXT I
670 INPUT#-1,A$
680 IFA$<>"END OF DATA" THEN ERROR 22
690 GOTO 80
700 PRINT@714,"TAPE ERROR - PLEASE TRY AGAIN":RESUME 605
```



by the amount of string storage space available in your machine.

Although the program was written as an animal guessing game it could be used for almost any sort of guessing. The program serves as a good example of a learning program and also illustrates the use of Binary Decision Trees. The program may be terminated by replying N when asked

Do You Want to Try Again

in which case the program will give you the option of saving all the animals and questions already entered into the program. The data is blocked up into records of five questions before being written to the cassette tape to speed up the reading and writing operations.

Important Variables

- Q(n) This holds the nth node. Each node will be either a question — e.g., has it got a trunk — or the name of an animal — an elephant.
- Y(n) This holds the number of the next question to be asked if the answer to the current question is Yes.
- N(n) This holds the number of the next question to be asked if the answer to the current question is No.
  Note: Y(n) and N(n) will both contain zero if Q(n) is the name of an animal.
- L Is the next free element of array Q.
- C Contains the number of the current question being asked.

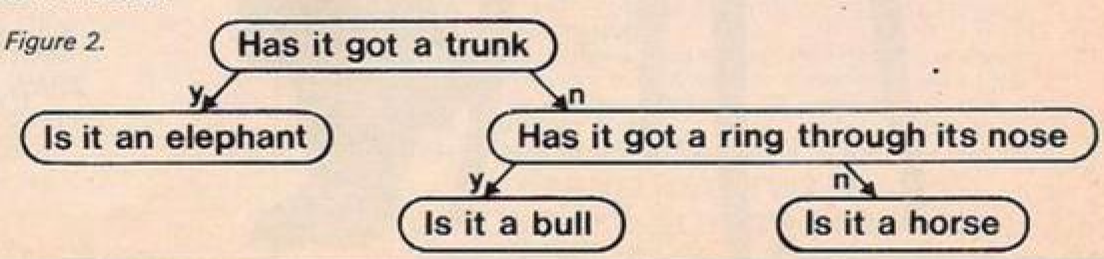
Figure 1.

```
GUESSING GAME © R H LANCASTER 1982
ENTER SELECTION L  LOAD DATA FROM CASSETTE
                S- SAVE DATA ON TO CASSETTE
                I- INITIALISE PROGRAM
? I
HAVE YOU THOUGHT OF AN ANIMAL?  Y
WAS IT AN ELEPHANT?  N
WHAT WAS IT?  A HORSE
WHAT QUESTION COULD I USE TO DISTINGUISH BETWEEN AN ELEPHANT AND A
HORSE?  DOES IT HAVE A TRUNK?
WHAT WOULD THE ANSWER FOR A HORSE BE?  N

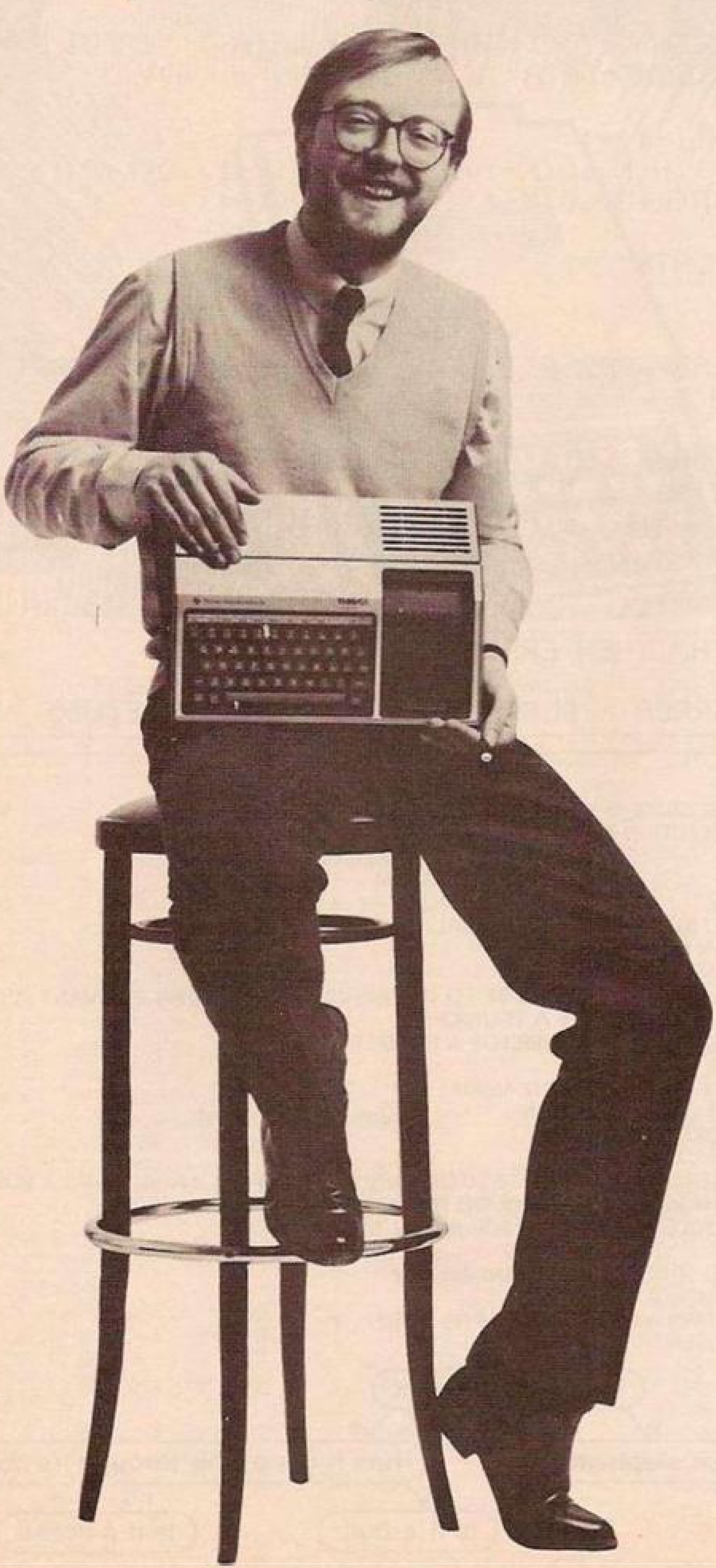
HAVE YOU THOUGHT OF AN ANIMAL?  Y
DOES IT HAVE A TRUNK?  N
IS IT A HORSE?  N
WHAT WAS IT?  A BULL
WHAT QUESTION COULD I USE TO DISTINGUISH BETWEEN A HORSE AND A BULL?
DOES IT HAVE A RING THROUGH ITS NOSE
WHAT WOULD THE ANSWER FOR A BULL BE?  Y

HAVE YOU THOUGHT OF AN ANIMAL?  Y
DOES IT HAVE A TRUNK?  N
DOES IT HAVE A RING THROUGH ITS NOSE?  Y
IS IT A BULL?
```

Figure 2.



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TEXAS INSTRUMENTS

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This month Tony Edwards tackles graphics conversion from Basic to Basic — by far the hardest task facing a programmer.

IF A PROGRAM is written for a microcomputer which has high-quality graphics, such as an Apple or UK101, it will be impossible to translate it directly for a machine with a smaller graphics set, such as a TRS-80.

Nevertheless, it is still possible to translate graphics if you know what the screen display of the original program should look like. You can then program a similar display for your machine, more in keeping with its graphics capabilities. This requires that you understand not only the graphics symbols used in the original program but also your micro's machine language. The tables with this article will help but first let us consider a direct translation.

BASIC GRAPHICS CONVERSION

Program 1 is a simple game program where the player uses keys 5 and 8 to catch falling bricks. It did not work on my computer so I marked lines 60, 110, 125 which appeared to be syntax errors as suggested in the first part of this series — April 1981 — and proceeded to alter them.

Most were straightforward. Line 60 is a random-number selection and, in my Basic, requires a Random to set the seed of the random-number generator. So I added a new line 0 to do this. I also took the opportunity to clear the screen at the start of the run and, as the original program was in integer Basic, all variables were defined as integers by Defint A-Z in this new line.

Line 110 obviously prints a Chr$ 137 — whatever that may be — somewhere on the screen. It then prints another unknown shape, Chr$ 128, somewhere else. This is difficult to translate directly, but knowing the game it is reasonable to assume that one is the brick and the other is the catcher. Furthermore, as the direction controls affect E — see lines 80 and 90 — the Chr$ 128 must be the brick.

The statement to be found at line 110:

PRINT AT D,B

does not mean anything to me, but noting that B is randomly selected at the start and that D changes as the game proceeds, it is easy to write a routine to cause a brick to drop and another to move the catcher horizontally.

Line 125 is more difficult as it prints a Chr$ 23 at some point on the screen. This point is seen to be the point of the catch. So, instead of Chr$ 23, I printed an asterisk.

Finally in line 160 the Stop is valid in my Basic, but as it is at the end of the program I substituted an End. Thus my new program is as shown in program 2. Note that the extra +1 in lines 120 and 125 is to compensate for the fact that in line 110 I have changed the length of the catcher.

The new program worked well — even to the point of reproducing the screen flicker. It is, however, still far from perfect. Lines 120 and 125 and 130 and 140 could be better programmed as could the delay in lines 20 and 30. The CLS in line 100 causes a flicker which should be removed. These changes are not really part of the translation, but satisfy the demands of good programming technique —

Figure 6.

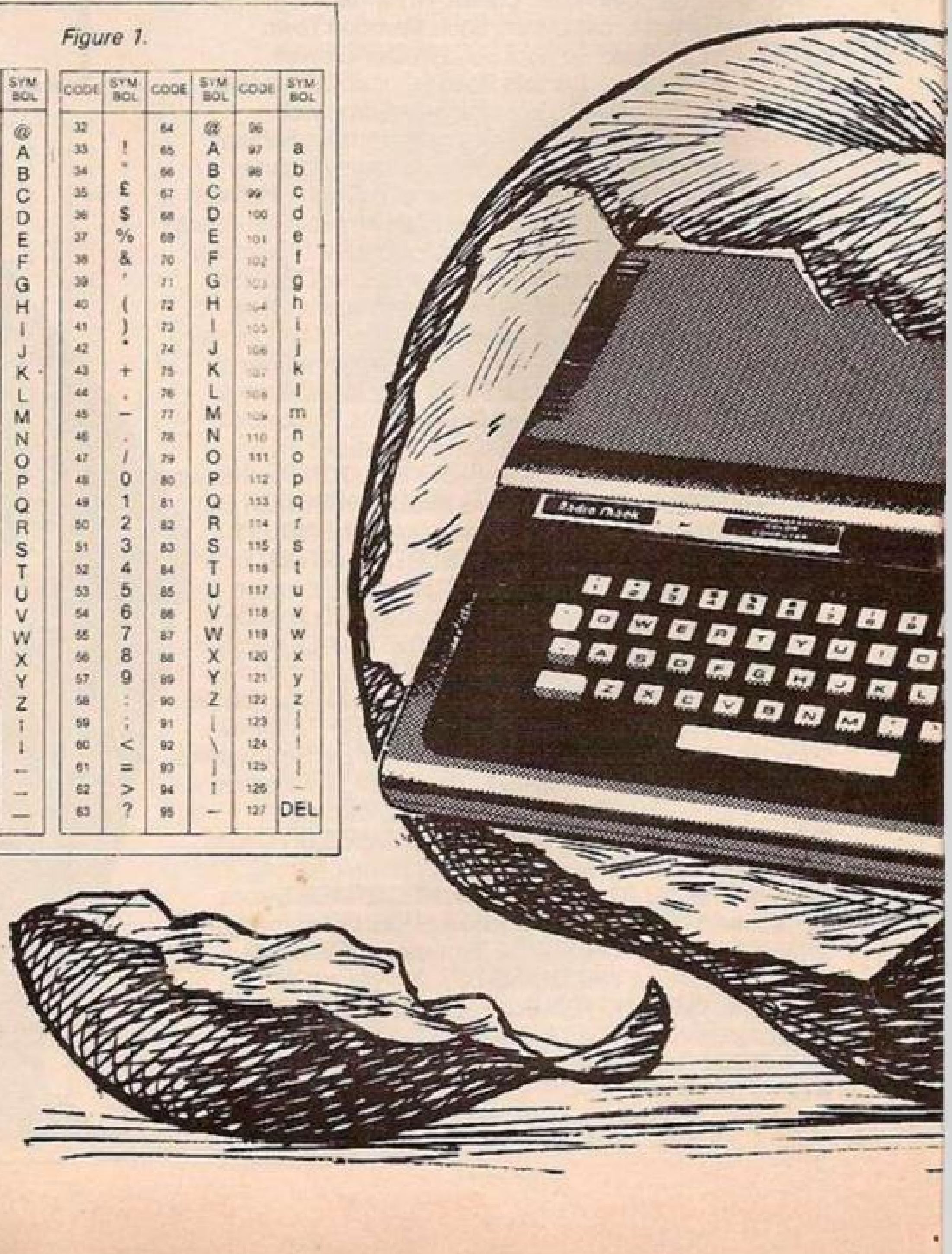
CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL
0	@	32		128	@	160	
1	A	33	!	129	A	161	!
2	B	34	"	130	B	162	"
3	C	35	#	131	C	163	#
4	D	36	$	132	D	164	$
5	E	37	%	133	E	165	%
6	F	38	&	134	F	166	&
7	G	39	'	135	G	167	'
8	H	40	(	136	H	168	(
9	I	41	)	137	I	169	)
10	J	42	*	138	J	170	*
11	K	43	+	139	K	171	+
12	L	44	,	140	L	172	,
13	M	45	—	141	M	173	—
14	N	46	.	142	N	174	.
15	O	47	/	143	O	175	/
16	P	48	0	144	P	176	0
17	Q	49	1	145	Q	177	1
18	R	50	2	146	R	178	2
19	S	51	3	147	S	179	3
20	T	52	4	148	T	180	4
21	U	53	5	149	U	181	5
22	V	54	6	150	V	182	6
23	W	55	7	151	W	183	7
24	X	56	8	152	X	184	8
25	Y	57	9	153	Y	185	9
26	Z	58	:	154	Z	186	:
27	[	59	;	155	[	187	;
28	\	60	<	156	\	188	<
29	]	61	=	157	]	189	=
30	^	62	>	158	^	190	>
31	—	63	?	159	—	191	?

Figure 2.

CODE	SYMBOL	CODE	SYMBOL
32		64	@
33	!	65	A
34	"	66	B
35	#	67	C
36	$	68	D
37	%	69	E
38	&	70	F
39	'	71	G
40	(	72	H
41	)	73	I
42	*	74	J
43	+	75	K
44	,	76	L
45	—	77	M
46	.	78	N
47	/	79	O
48	0	80	P
49	1	81	Q
50	2	82	R
51	3	83	S
52	4	84	T
53	5	85	U
54	6	86	V
55	7	87	W
56	8	88	X
57	9	89	Y
58	:	90	Z
59	;	91	↑
60	<	92	↓
61	=	93	←
62	>	94	→
63	?	95	—

Figure 1.

CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL
32		64	@	96	
33	!	65	A	97	a
34	"	66	B	98	b
35	£	67	C	99	c
36	$	68	D	100	d
37	%	69	E	101	e
38	&	70	F	102	f
39	'	71	G	103	g
40	(	72	H	104	h
41	)	73	I	105	i
42	*	74	J	106	j
43	+	75	K	107	k
44	,	76	L	108	l
45	—	77	M	109	m
46	.	78	N	110	n
47	/	79	O	111	o
48	0	80	P	112	p
49	1	81	Q	113	q
50	2	82	R	114	r
51	3	83	S	115	s
52	4	84	T	116	t
53	5	85	U	117	u
54	6	86	V	118	v
55	7	87	W	119	w
56	8	88	X	120	x
57	9	89	Y	121	y
58	:	90	Z	122	z
59	;	91	[	123	{
60	<	92	\	124	¦
61	=	93	]	125	}
62	>	94	↑	126	~
63	?	95	—	127	DEL



```
10  PRINT "USE KEYS 5 AND 8 TO CATCH BRICKS"
20  FOR S=500 TO 1 STEP-1
30  NEXT S
40  LET E=15
50  FOR A=0 TO 20
60  LET B=INT(RND*25)
70  FOR D=0 TO 20
80  IF INKEY$="5" THEN E=E-1
90  IF INKEY$="8" THEN E=E+1
93  IF E<0 THEN LET E=0
97  IF E>31 THEN LET E=31
100 CLS
110 PRINT AT D,B;CHR$137; AT 20,E;CHR$128
120 IF D=20 AND B=E THEN LET S=S+1
125 IF D=20 AND B=E PRINT AT 20,E;CHR$23
130 NEXT D
140 NEXT A
150 PRINT "THAT'S ALL SCORE";S
160 STOP
```

Program 1.

Graphic Block Codes

Block Code = 128 +

1	2
4	8
16	32

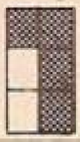
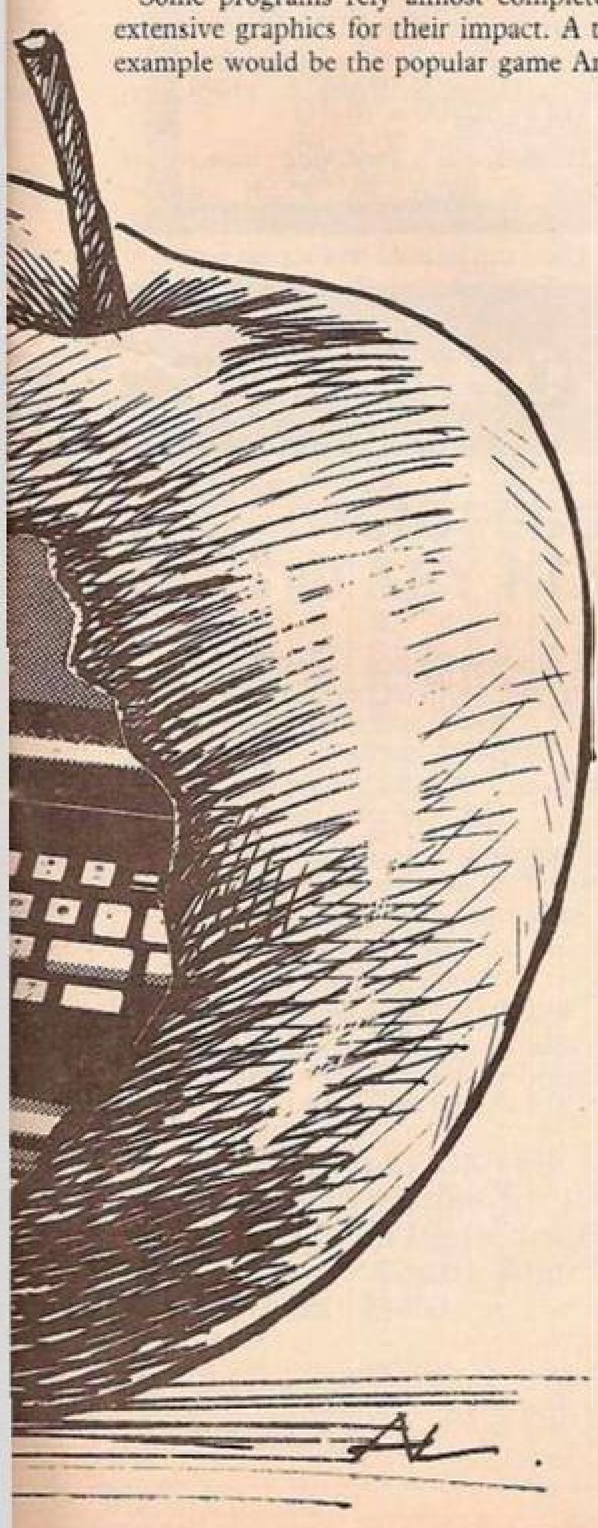
ie  = 128 + 1 + 2 + 8 + 32 = 187

Figure 3.

such improvements should be made in the course of developing any program.

This has been a very straightforward translation, but it serves to show how simple graphics can be translated with the help of the same techniques used for non-graphics. However the real challenge arrives when we consider translating more complex graphics.

Some programs rely almost completely on extensive graphics for their impact. A typical example would be the popular game Android



```
0   RANDOM DEFINT A-Z CLS
10  PRINT "USE KEYS < AND > TO MOVE"
20  FOR S=500 TO 1 STEP-1
30  NEXT S
40  E=15
50  FOR A=0 TO 20
60  B=RND(25)
70  FOR D=0 TO 12
80  A$=INKEY$ IF A$="," THEN E=E-1
90  IF A$="." THEN E=E+1
93  IF E<0 THEN E=0
97  IF E>31 THEN E=31
100 CLS
110 PRINT @(64*D)+B,CHR$(191) PRINT @(12*64+E),CHR$(191);
    CHR$(176);CHR$(191)
120 IF D=12 AND B=E+1 THEN S=S+1
125 IF D=12 AND B=E+1 THEN PRINT @(12*64+E+1),"*"
130 NEXT D
140 NEXT A
150 PRINT "YOUR SCORE IS";S
160 END
```

Program 2.

Nim which is available for the TRS-80/Genie microcomputers. The programming of the game of Nim is very simple, but it is the actions of the androids which gives the game its charm.

In a case such as this I would advise against any attempt at direct translation. Rather you should use the idea to form the basis of a new program for your computer. Conceiving the idea for a program is often the most difficult part; once you have grasped the idea programming it is rarely that laborious.

The problem remains of how to understand the concept of a program from a listing. If you are lucky a friend or a fellow member of your computing club may be able to show you the program up and running on the machine it was written for. However, it is more likely that you only have the listing to go by so you must understand the graphics used.

The standard code known as the American Standard Code for Information Interchange, or ASCII for short, is based on a seven-bit binary sequence providing 127 different codes — both 0000000 and 1111111 are considered as "null". The eighth bit is used for parity checking. Most microcomputers have character sets based on this code, usually with some additional non-alphanumeric characters.

Figure 1 gives the standard ASCII set except for codes 0 to 31 which are used as special control functions. A similar basic set will be found on most micros, usually with code 35 as # rather than £. All the figures in this article are printed in reverse.

Figure 2 shows the character set for a TRS-80. The Genie has a similar set except for codes 91 to 94 which, on the Genie, are [, /,] and <. On both these machines codes 96 to 127 are non-displayable and the upper-case letters are displayed in their place. A point to note, however, is that A and "a" both appear as A on the screen but are not equal if compared as string characters using the ASC comparison.

On these machines codes 128 to 191 are pixel characters whose values are calculated by adding the individual values of the pixels which are switched on — see figure 3. Codes 192 to 255 are known as space compression codes and are used to print a series of blanks. The formula for the calculation of the number of blanks is:

Number = Code 192

That is, Code 192 prints zero blanks and code 255 prints 255−192 which equals 63 blanks.

The TRS-80 and Genie have screens consisting of 16 lines of 64 characters and both have the facility to use a 32-character mode. Important control codes are 14 cursor on, 15 cursor off, 23-32/64 characters. This is for the TRS-80 only — this function is hardware-

Figure 5.

	MEANING
Q	DOWN CURSOR
]	CURSOR RIGHT
□	CURSOR UP
■	CURSOR LEFT
S	HOME CURSOR
♥	CLEAR SCREEN
R	REVERSE FIELD
▬	OFF REVERSE FIELD

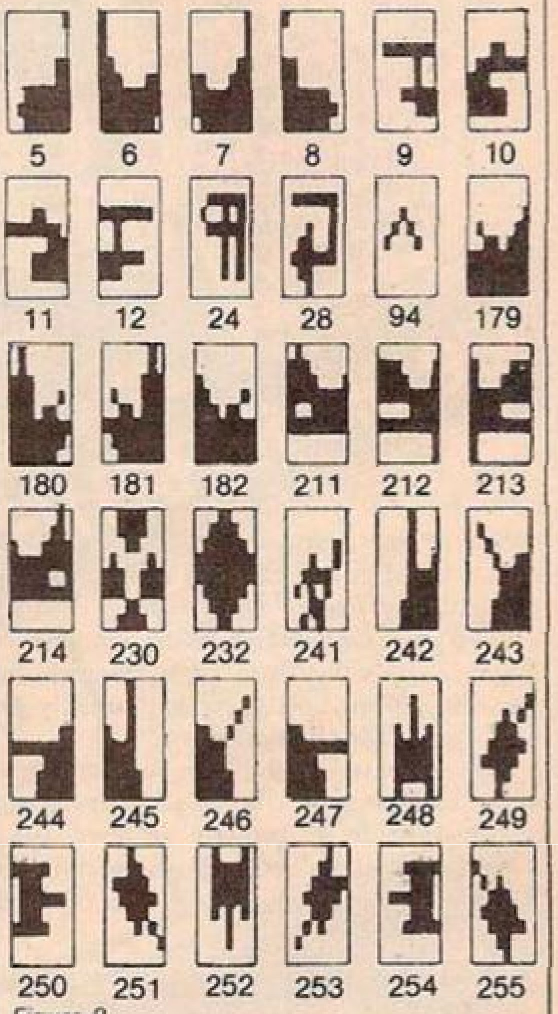


Figure 8.

switched on the Genie, 28 home cursor to top left, 30 erase to end of line and 31 erase to end of frame.

The Pet has a screen format of 25 lines of 40 characters and its set is shown in figure 4. No lower-case characters are shown, but these can be produced by Poke 59468,14 and using the graphic codes. To revert to graphics, Poke 59468,12. The Pet uses Chr$(147) to clear the screen and also uses some special characters as control codes and these are reproduced as figure 5.

The Apple can provide regular, reversed and flashing graphics and figure 6 shows the codes. Codes 64 to 159 are the same as 0 to 95 but flash. There are no lower-case characters. The screen format is 24 lines of 40 characters, and there are both high- and low-resolution graphics modes. In low-resolution mode there are 40 by 48 graphic blocks which can be switched on or off, but high-resolution mode special characters can be developed from a 280 by 192 screen.

The various modes are switched using the commands HGR2, Text, and GR and by Pokes in the memory area 16297 to 16302. Some special functions which may be encountered on the Apple are Call-936 which

(continued on next page)

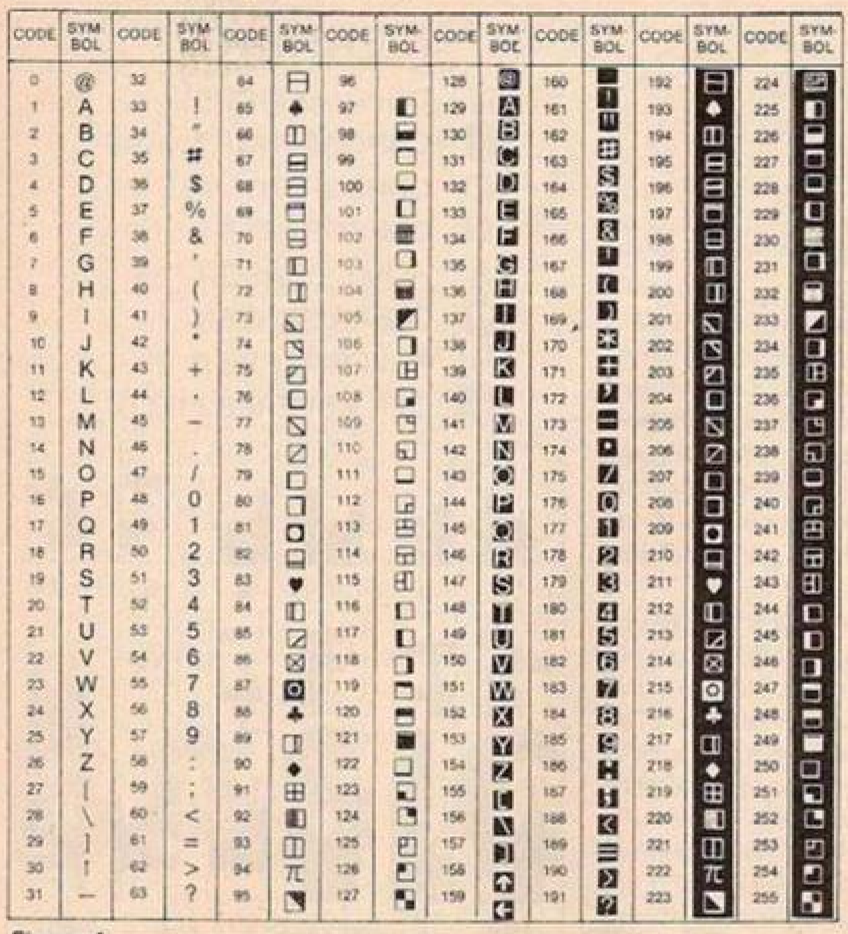


Figure 4.

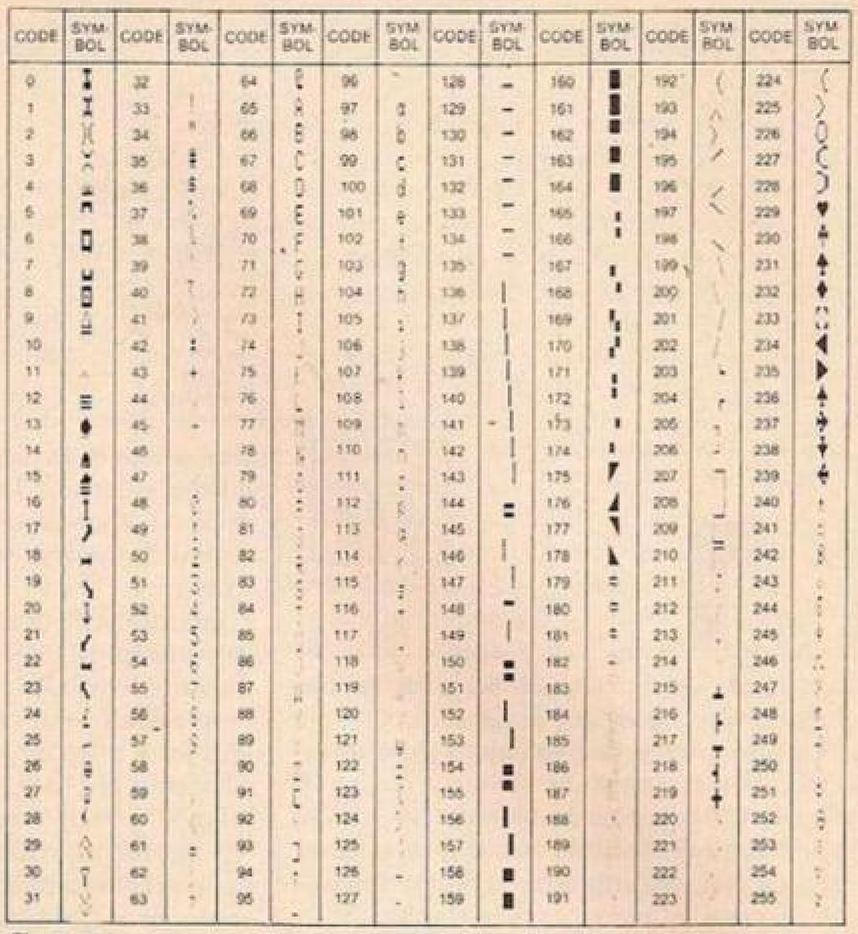


Figure 7.

(continued from previous page)

clears the screen and Call-958 which clears to the end of the frame.

Apple programmers have to use a number of Pokes in both low and high memory for graphics control and these can usually be safely ignored in translation.

The control sets used for the popular single-board machines, the UK101 and Superboard II, are difficult to delineate as there are a number of monitors in use which use different sets. However, the character set is constant and is shown in figure 7. The Superboard II has the same graphics set except for the 36 character shapes shown in figure 8. The Superboard's screen format is 16 lines of 51 characters and UK101 format is a 25 by 25 square.

The Sorcerer's character set is very large as there are in fact 18,446,744,073,709,550,000 different graphics shapes available — or so the manual says — but they can be quickly defined by stating that each shape consists of an eight-by-eight matrix of switchable points. Of these the standard 128 characters of the alpha-numeric set are stored in ROM and 128 more are held in RAM but are user-definable. This basic set is shown in figure 9. The screen format is 30 by 64.

The MZ-80K has a very wide character set as shown in figure 10, which includes "person" shapes and non-standard alphabetics. These can be used on a screen format of 25 lines of 40 characters, but in addition any cell of a 50 by 80 grid can be switched using the Set and Reset commands. Chr$(198) is the call for clear screen.

Figure 9.

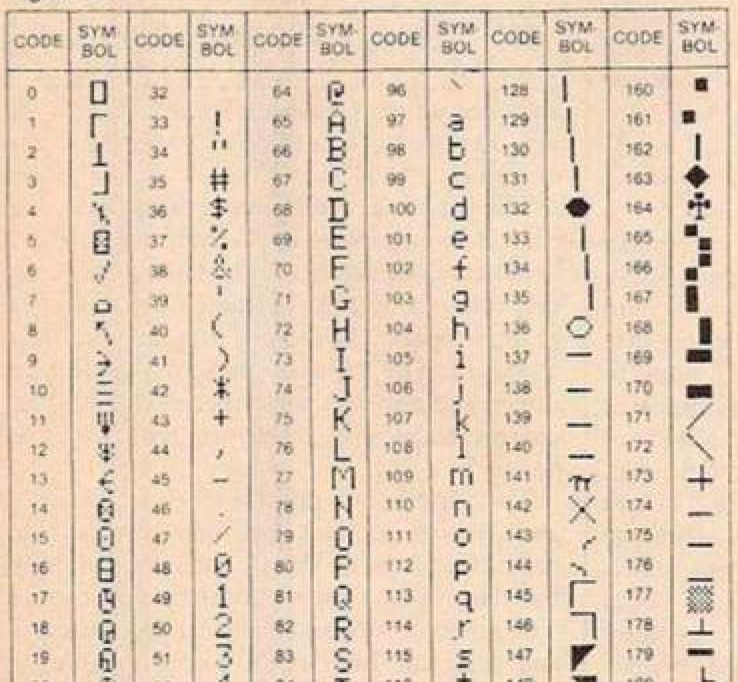
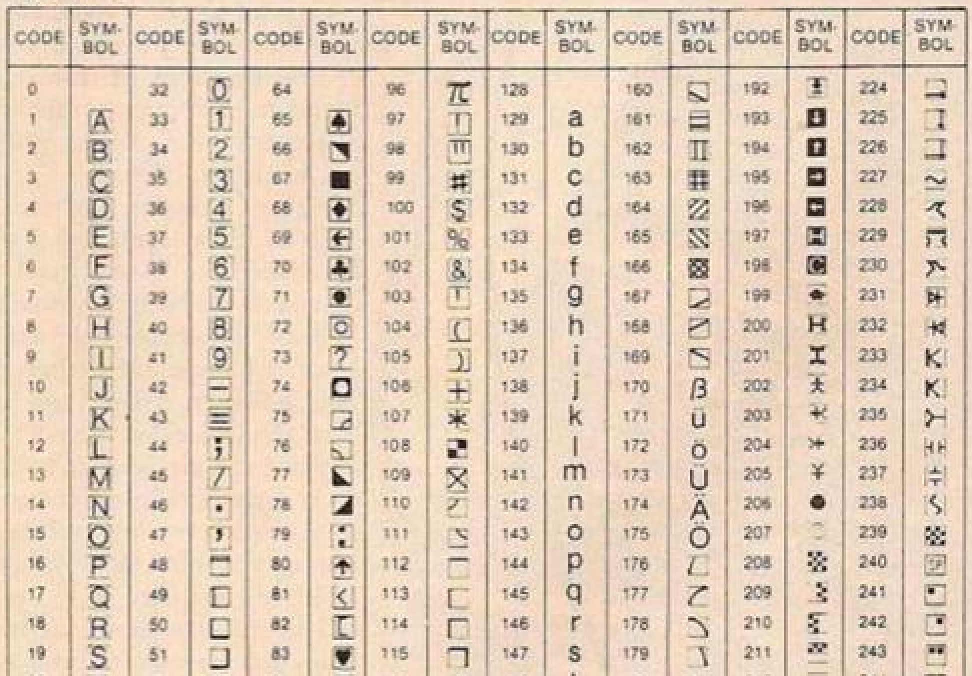
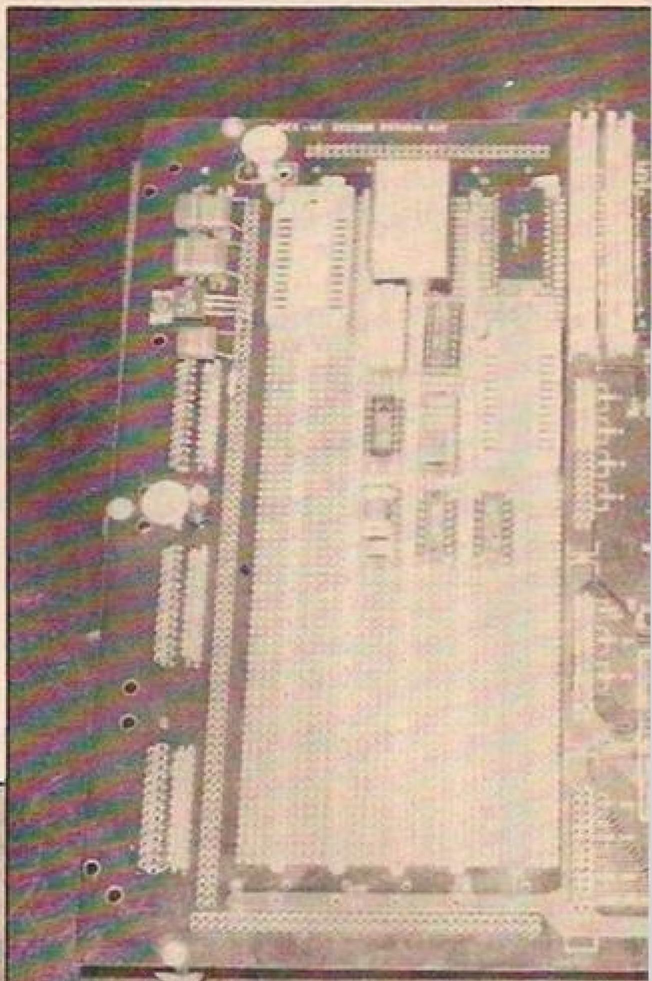


Figure 10.



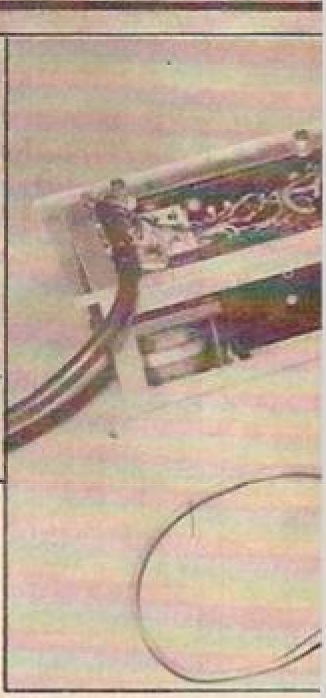
PROJECT

BLOWING YOUR OWN EPROM



John Dawson reveals how you can program EPROMs in the comfort of your own home using commercial devices or by building your own.





Right, photo 1, the Microtanic programmer. Top, photo 2, the single-board micro with EPROM programmer. Left, photo 3, Northern Electronics eraser and far right, photo 4, the home-made device.

WHEN ROBERT HEINLEIN wrote *The Door into Summer* he described Programmable Read Only Memories (PROMs) in these words:

> Here is where the Thorsen memory tubes came in . . . No need to go into the theory of an electronic tube that even Bell Labs doesn't understand too well. The point is that you can hook a Thorsen tube into a control circuit, direct the machine through an operation by remote control, and the tube will "remember" what was done and can direct the operation without a human supervisor a second time, or any number of times . . . Frank's square head could easily hold a hundred Thorsen tubes, each with an electronic memory of a different household task.

Not bad for 1957. Read Only Memories (ROMs) have progressed enormously in the last four or five years. Prices have dropped, capacity has increased and, most important of all, the ease with which you can program and subsequently change a program in one of these devices has altered out of all recognition.

A ROM is an integrated circuit into which a certain bit pattern has been built at the time of its manufacture. The program is inserted by means of a photo-mask for each circuit layer; this is an expensive process unless the maker intends to produce several thousand chips.

For a smaller number of ROMs it is usually economical for an equipment manufacturer to buy Programmable Read Only Memory (PROM) chips. These have a fusible link in each cell and the bit pattern can be set in the chip once and for all by blowing selected fuses to create open circuits where required. The information stored in the PROM can be changed only by blowing more fuses, and creating more "on" states in the bit pattern.

Eventually, having started with a device set completely to off states, you would end up with the opposite — a chip full of on states. Both of these methods were fine once a manufacturer was in full-scale production but of little use in a research-and-development laboratory.

One type of ROM can be reprogrammed during operation in the computer; however, Electrically Alterable Read Only Memory chips are slow and still expensive. An EPROM-like device is CMOS Random Access Memory which is now available with small lithium batteries built on to the chip to keep the program contents of the integrated circuits intact when the main power to the computer is switched off. Like the EAROM this is still an expensive method of maintaining a program but it has many advantages and is likely to follow most other pieces of hardware in becoming very much cheaper. The most common ROM chips are now EPROMs.

Erasable Programmable Read Only Memory (EPROM) or Electrically Programmable chips were developed to allow the same integrated circuit to be used more than once. EPROMs have a multitude of uses. In addition to their most common function — storing a monitor program that contains the essential start-up instructions for the computer — EPROMs have been used for holding mathematical look-up tables, wave-form data, identity codes for securing computer terminals against unauthorised use, and data for speech synthesis.

Upper and lower gates

Typically an EPROM consists of thousands of Field Effect Transistors (FETs) each having two gates. The lower gate floats and controls the state of the FET — binary 1 or 0, on or off — while the upper gate selects the transistor when it is to be read by the computer.

Programming the EPROM is carried out by injecting a charge on to the lower gate. The charge is put on to the gate by applying a powerful 25V pulse for one-twentieth of a second and the gate is so well insulated that the charge will remain for several years without leaking away.

Erasing the EPROM consists only of exposing the surface of the silicon chip to strong ultra-violet light which allows the charge on all the lower gates to leak away.

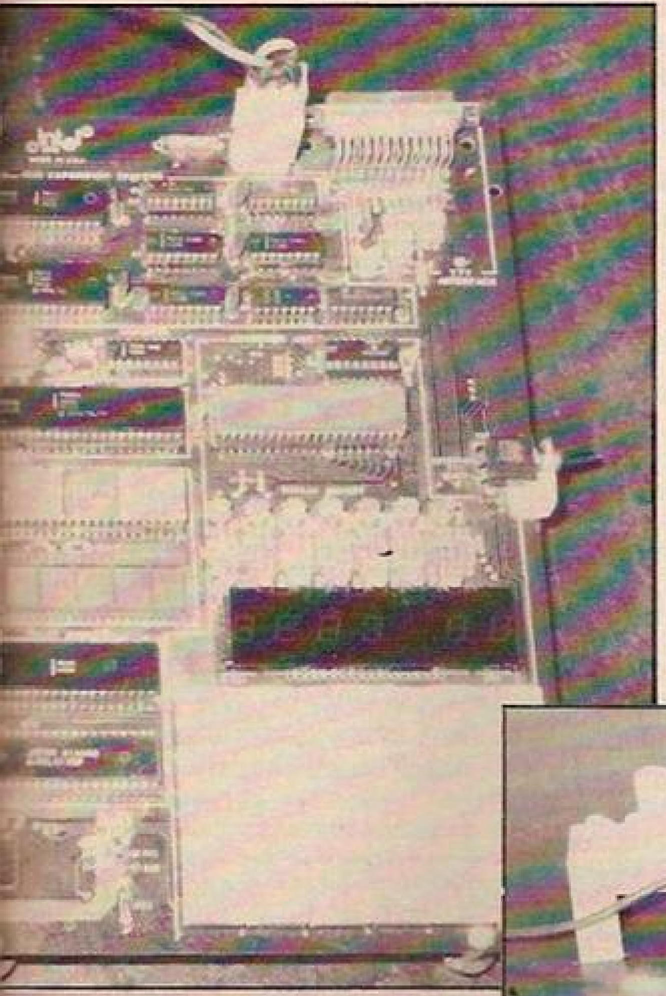
If you are considering programming your own EPROMs I suggest that you standardise on chips such as the 2716, 2516, 2732 and 2532. Use integrated circuits that need a single 5V supply rather than the older 3V models, and convert your computer if necessary — the three-rail chips are becoming increasingly expensive as demand drops.

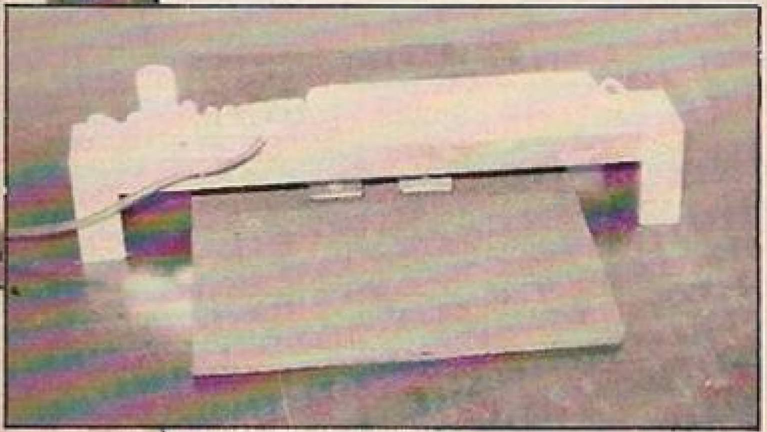
Another advantage to the modern integrated circuits is their capacity to be programmed a single location at a time. The older 2708 EPROM required you to program all of the 1K memory in a single run.

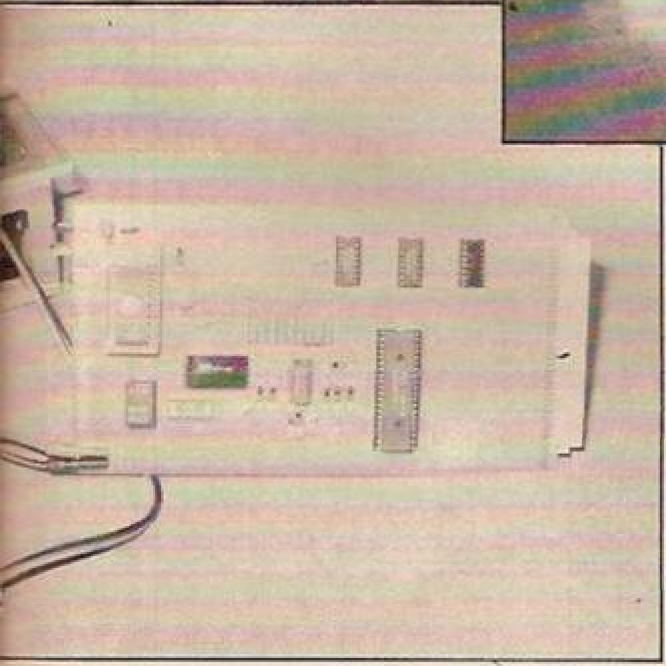
EPROM programmers are available for many personal computers. The "standard" amateur design tends to use a timer in the computer to produce the programming pulse of 50ms. and three eight-bit ports for the data and address lines.

HANDICAPPED COMPETITION

In Information Technology Year, *Your Computer* is sponsoring a competition to aid the handicapped. The competition, which is divided into two sections, is to design a device which helps disabled people to use a microcomputer to overcome their handicaps. All entrants to the competition must write up to 2,000 words describing such a device. In addition, entrants over the age of 18 will be expected to show a prototype device in action. More information about the competition and its rules will be found in *Your Computer,* April edition. The competition closes on August 31.







Photograph 1 shows the EPROM programmer available from Microtanic Software Ltd for the Tangerine Microtan computer. This programmer works well and is easy to use. Unlike many of the more economical devices, it plugs into the motherboard of the Tangerine system and does not require drooping lengths of ribbon cable.

The board could be made even more convenient by the addition of an on-board 25V supply for the programming voltage but that would have put the price up and it is relatively easy to use either three PP3 batteries connected in series of a mains power-supply unit.

Photograph 2 shows another approach; a single-board 8085 evaluation computer adapted for use as an EPROM programmer. The software to control the programmer is held in the large CMOS RAM package and the board accepts data to be programmed through an RS-232 interface.

Remember that the CPU in the EPROM programmer is immaterial to the information that you wish to program into the EPROM. A programmer based round an 8085 CPU can handle 6502 machine code as well as Z-80 or 8080 code. The two Zero Insertion Force (ZIF) sockets allow one EPROM to be copied into RAM on the board before it is programmed into another EPROM in the second ZIF.

Two important warnings are necessary about EPROMs. You must never reverse the programming voltage and that includes oscillation on the programming supply line caused by a mechanical contact closing. The switch bounce can cause ringing which will destroy an EPROM.

The Microtanic Software Programmer uses a relay to switch both the 5V and 25V supplies but is careful to debounce the contacts and prevent negative voltages appearing on the line. Secondly, you should check that the programmer software can never allow the computer to lock up with the programming voltage applied to a location on the EPROM. This too will destroy the EPROM, either partly or completely. The software should be able to cope with system resets, keyboard interrupts without deviating from the 50ms.

When you find that the program you have written does not work, you will want to erase the EPROM and start again. You can do this as many time as you like — EPROMs do not wear out from reprogramming.

The erasure characteristics of the 2732 are such that loss of charge on the floating gates begins to occur when the chip is exposed to light with a wavelength shorter than 400nm. Sunlight and fluorescent tubes emit light in the region 300 to 400nm. Constant exposure to room-level fluorescent lighting could erase a typical 2732 in about three years. Direct sunlight would take less time, wiping the bit pattern stored in the chip in approximately one week.

The window of the EPROM should be covered with an opaque label to prevent an accumulation of ultra-violet energy which could make random bits unreliable in operation before any full-scale erasure was noticeable.

EPROM erasers use mercury discharge tubes to provide a source of ultra-violet at a wavelength of 254nm. To completely "wash" a 2732 EPROM you will need to provide a dose of ultra-violet of about 15 Watt-seconds per square centimetre. The power of various ultra-violet lamps varies widely but the two erasers shown in this article will provide this dose in about 10 minutes when the EPROM is approximately 1in. from the tube.

The EPROM eraser shown in photograph 3 is made by Northern Electronics, Mossley, Lancashire and is a compact unit about 3.5in. by 7.5in. by 2in. in size. The unit uses a Phillips ultra-violet lamp with a claimed life in excess of 3,000 hours. The drawer in which the EPROMs are placed activates a micro-switch when it is almost fully closed and this switches on the ultra-violet lamp.

The UV1B eraser will wash six EPROMS at a time although the erasing time rises as devices are placed close to the ends of the ultra-violet lamp. It will erase four chips at once in eight to 10 minutes.

The UV1B is a neat, safe, and satisfactory device which should have a long life. The only part that will deteriorate with use is the lamp, and replacements currently cost about £11. The whole eraser costs about £45.

Home-made approach

A home-made approach is shown in photograph 4. The fluorescent tube is clear and has no powder coating to obstruct the mercury discharge light. The tube is mounted on a section of aluminium channel with an 8W choke on the top and legs at each end to raise the lamp away from the EPROMs. The ultra-violet tube is available from Anderman and Company Ltd, Laboratory Supplies Division, Central Avenue, East Molesey, Surrey KT8 0QZ — telephone 01-979 8112 — and is known simply as a short-wave tube 254nm.

The main disadvantage to the second eraser is the lack of any interlock to prevent you looking at the ultra-violet light. You should be aware that this light can burn your skin and could cause a condition similar to snow-blindness if you look at the tube for any length of time.

I use the old oven timer shown in the photograph to control my eraser; both to prevent overexposure of the EPROMs and to save the lamp.

CONCLUSIONS

- Programming your own EPROMs is not difficult or time-consuming.
- At 50ms. for each byte, it takes approximately three and a half minutes to "blow" a 4K 2732 chip.
- The knowledge that you have the ability to fix a well-used program incorruptibly in read-only memory, and have it instantly available, is a real leap forward in your own personal computer technology. ■

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Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried – whatever it is, Tim Hartnell will do his best to answer your queries. Please include only one question per letter and mark them "Response Frame".

REAL KEYBOARD

■I own a ZX-81 computer and have just decided to add a real keyboard. I have several push-to-break switches. Could these be used with the ZX-81 to make a real keyboard.

R Beeston,
Kippax, Leeds.

You need push-to-make switches. You can buy these separately very cheaply, or buy a second-hand keyboard to adapt. There are a number of very good keyboards on the market for the ZX-81, starting from around £20 – see June's *Your Computer* – and you may well decide it is a better bet to buy one of these than to make your own. If you do buy a second-hand one, keep in mind that the ZX-81 does not use the ASCII code which most keyboards were built for, so you will have to bypass the ASCII bits. A non-ASCII keyboard may well be cheaper, and is ideal. Henry's in Edgware Road in London often have suitable second-hand keyboards in stock, as do many other electrical hobbyist stores.

SELF-STARTER

■Much of the ZX-81 software advertised in your magazine is self-starting. Could you please explain how this is achieved.

Martin Kuhn,
Stevenage, Herts.

All you have to do, is make the first line of the program

```
SAVE "PROGRAMNAME"
```

and the program will Run automatically on being Loaded.

LOAD OF LABOUR

■I have recently purchased a Sinclair ZX-81 computer with a 16K RAM pack, and have to agree with their claim that a complete novice can write a program within an hour. However, I am having great difficulty with saving and loading. I have been getting your magazine since January, and have tried the suggestion put forward by one reader of disconnecting the microphone plug and holding it, but this does not help. I can load some pre-recorded programs, but I am puzzled to find that, with some cassettes, only two of the three programs will load. Surely they should all be equally acceptable? Just once, in several attempts, one particular 16K program loaded properly — a game called Labyrinth. But on trying it again last weekend it loaded only partially. That is, the listing came up, but with the letters slightly distorted, and a great many of them incorrect as if a very bad typist had typed in the program, and with a "black road" trailing off the bottom of the screen. Of course it refused to run.

From this information, could you suggest what is likely to be wrong?

E M Worth,
Bournemouth.

Many ZX-81 owners have loading problems. The solution is to experiment with your computer and recorder The basic steps I suggest include always using computer-quality, C-12 or C-15, cassettes and cleaning the heads with liquid, not a tape, every time before you load and save. Ensure the leads from the tape recorder do not overlap the lead connecting the power supply to the computer. Write a short, two-line program, and save it. Practise loading it back over and over again, adjusting the volume a fraction each time. When you achieve a successful load, mark the spot on the volume control, so you can set it again in the future. When you manage to successfully load a commercial tape, save it yourself on a separate tape, and always use this to load from. You should have far greater success loading from your own tapes than from those prepared by others.

BBC CONFUSION

■I have ordered a BBC Microcomputer which I should be receiving in the next two months. Since I already knew ZX-81 Basic, I decided to learn some BBC Basic before the machine arrived, and bought the *BBC/NEC 30-Hour Basic*. After reading it, I found a report on the BBC's graphics in your April issue and after reading that, I was totally confused. Could you explain the difference between Move and Draw? Why the co-ordinates for the upper right-hand corner are 1280,1024? Why when in Mode 0 the resolution is 640 by 256 and why BBC Basic's Plot has three numbers after it whereas ZX-81 Basic has only the co-ordinates?

Stephen D King,
Casalpalocco, Rome.

Move moves the cursor to the position specified, and so Move 0,0 will move it to the bottom left-hand corner. If you do not specify a cursor location the computer assumes you want to start in the bottom left-hand corner, and will Draw from that position. Draw produces a line from the current cursor position to the new position, so

```
MOVE 50,50:DRAW 50,50
```

will move the cursor to location 50,50 and then draw a line from that point to 100,100.

The BBC Basic's Plot command has three parameters because the first specifies the kind of Plot you want. For example, if X and Y are the co-ordinates Plot 4,X,Y will move to the position X,Y while Plot 0,X,Y will move to X and Y relative to the last point the cursor occupied. A full description of the various Plot commands is in the BBC manual.

No matter what mode the computer is in, the co-ordinate numbers do not need to be reformatted, so a graphics program written for one mode will automatically be correct for any other graphics mode. This makes mode interchange very simple.

PET ON VIC

■I own a Vic-20 which I bought a few weeks ago. Previously I had access to the school's old-ROM 2001 series 8K Pet. Can I use the Pet games on the Vic-20?

A Rashid,
Bradford.

The Commodore machines have good compatibility. The main differences are in screen Pokes and general display organisation. The relatively coarse graphics of the Vic will mean you will have to simplify and rewrite the program output. Apart from this, you should have no problems entering the programs into your Vic. The colour organisation, location and colour Pokes are, however, unique to the Vic so if you want colour, you will have to add this later to the programs you enter which were originally written for the Pet.

MUSIC SYSTEM

■I am a newcomer to computing and would appreciate your advice on what kind of system to purchase. I have done some programming in Basic on a Commodore Pet while on an Employment Rehabilitation course, but am doubtful that I could afford this system, and at present I am more attracted to a ZX-81. I am looking for a computer system to replace my existing card index of music recordings. I need a system which will search through a file for any name or title which I enter, and give me enough information to find a recording from the records and tapes which I possess. The system should also be able to give me lists of various types, in a logical sequence. For example, I would periodically require a "stock list" in artist name order, subdivided into albums, 45 rpm singles and tape recordings. Naturally I would also need to be able to update the file each time I purchased or made a new recording. I have about 600 singles, 150 LP discs, and 200 C-90 and C-60 tapes, a total of between 10,000 and 12,000 records. I would be willing to spend up to about £400 on a computer system. Could you please tell me whether the ZX-81 would be able to cope with my needs, and if not what system would you suggest?

R E Hollings,
Scarborough, Yorkshire.

My initial reaction is that, if your card system works well, and you can find any record within a minute or so, to forget completely about computerising the system. Have you thought how long it would take to get the information into a computer? The typing involved would be equivalent to typing a very large book, but with much greater care needed than just straight typing. If you are willing to face this daunting task, please read on. The input/output demands you specify are not very difficult. Any computer, including a ZX-80, could handle the sorting and splitting up into categories you specify, although the memory you will need for your task is quite formidable. A single track would require the following information to be stored: Medium (LP, 45 or tape), name of tape/album, name of artist, name of track, location of track, reference number or code. Multiply this by 12,000 and you will need a massive amount of memory, certainly more than would fit on a 16K or even a 64K ZX-81. The ZX Spectrum may prove ideal once Sinclair introduces the Microdrive storage system. You could of course store the data on a cassette but as a cassette is a serial device, that is you have to look through everything in order, the time involved would not be worth it. You really need a disc-based system to fulfil your needs, and you may well find this takes you far beyond your financial resources.

MACHINE CODE

■I am 14 years old and I own a 16K ZX-81. Please could you recommend a book to introduce me to machine-code programming. At the moment the subject baffles me. Also, in the March edition of *Your Computer*, line 600 of Molecules was only half-printed in my issue. I buy your magazine regularly, and I think it is great.

D Frampton,
Bridgewater, Somerset.

Thanks for the comment on the magazine. I have heard good reports about two books, with several people saying that what they cannot understand from one book is made clear in the other. They are *Mastering Machine Code On Your ZX-81* by Toni Baker at £7.50 and *Machine Language Made Simple* at £8.95. Both books are available from most computer shops. *Programming The Z-80*, by Rodnay Zaks, is deal for further reading. Line 600 in the program Molecules should read:

```
600 IF D>9 THEN PRINT AT
  19,5+(P*2-1);CHR$ 136
```

■

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Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.

THE SHARP PC–1500

David Pringle puts the new Sharp PC-1500 pocket computer through its paces to see if it lives up to the claims its manufacturer has made for it.

SHARP'S FANFARE for its new PC-1500 Basic programmable pocket computer claims that: "This machine is capable of many of the functions which only a few years ago would have filled a warehouse with tubes, wires and engineers".

The company has undoubtedly introduced the most advanced machine of its sort. Although I have no doubt that it is a computer you may need very large pockets.

This latest solid-state marvel, fitted to its printer and cassette interface, tips the scales at over three pounds and measures around a foot long. I would rather call it a brief-case computer.

At first sight the PC-1500 is quite similar to the PC-1211. The same QWERTY keyboard, uncluttered by the current vogue of sub- and super-script functions and with quite reasonable key spacings, makes entry fingering easy. The positioning of a few of the keys has changed and a longer space bar helps. Significantly there are six new user-definable keys just below the enlarged 26-character LCD, which may define up to 18 different functions or Basic phrases to a single keystroke.

The powerful Def key assigns 10 of the most commonly used Basic keywords to the top QWERTY line of the keyboard and may also be used to run any program which has been labelled by a character from the other two alphabetic lines.

The interior changes are more significant. The old pair of four-bit Cmos chips operating in tandem has been usurped by a single new eight-bit processor with a consequent increase in calculation speed. Most importantly, the 16K of system ROM contains a new enhanced Basic.

The user has 2.6K of RAM available — 1,850 bytes in the main data and program memory, 624 in fixed memory and 188 in the reserve memory. Data and programs are fully merged apart from the locations for numeric and character variables A to Z and A$ to Z$ respectively in the fixed memory. Data starts filling up memory at the opposite end from programs, which are ordered strictly according to their Basic line number.

Calculator enthusiasts must take great care, without the pampering of individual program registers and passwords. The only statement separating programs in memory is an End and there is nothing to prevent the insertion of a line in the wrong program by virtue of bad numbering. Maximum program capacity corresponds to 1,850 steps, not an immense enlargement on the 1,424 available on the PC-1211. This may be increased to a very acceptable 5,946 steps with the optional CE-151 4K RAM module or the new 8K RAM.

The mode of operation is displayed on the LCDs. Program mode enables the writing and editing of program lines. As in all Basic each line must be numbered but this machine is user-friendly. For example, type in the garbage:

```
10IFA>10GOTOY
```

and on Entering, the line is accepted as:

```
10 : IF A>10 GOTO Y
```

If the entered statement does not make any sense or refers to an invalid condition then an Error display appears and the Sharp displays the offending line on pressing the ◀ key.

Direct editing is performed within the Delete and Insertion keys in conjunction with a cursor which roams freely throughout program memory. Accompanied by the new Tron debugging mode for step-by-step analysis of program running these features form one of the best editing combinations that I have seen on a small machine.

The new Sharp Basic is surprisingly advanced. The number of available statements and functions have doubled since the PC-1211.

The 1500 can now handle one- or two-dimensional arrays with a maximum of 256 columns and/or rows, although the required number of memory locations is n(columns) × n(rows) — arrays are memory intensive. These arrays may be in numeric or character variables and must be declared by the Dim statement. A character array, A$, of X rows and Y columns is declared as Dim A$(X,Y) *Z where Z is the string length.

It is also possible to use the fixed memory locations as a one-dimensional array up to 26 characters long. In this case the array must be named @ or @$ and need not be declared.

(continued on next page)



(continued from previous page)

Character string handling has been improved by the insertion of many new commands which Micro buffs will recognise such as Len$, which evaluates the number of characters in a specified string; Str$, which allows numeric characters to be included in strings; Inkeys$, Mid$ etc. A new Data statement enables the input of values for any combination of character and numeric variables so long as its partner the Read statement is suitably formatted.

All of the Data elements of a program are grouped together in one block of memory, so the lines

```
10 DATA 1,"and",3
20 READ A,C$,D
```

and

```
10 DATA 1,"and"
20 READ A
30 DATA 3
40 READ C$,D
```

are equivalent. A useful Restore command will set the next Read statement back to the beginning of the Data file.

New On Gosub and On Goto statements allow computed transfer of program control. The range of available standard numeric functions is identical to the PC-1211, so the 1500 still lacks hyperbolic and statistical functions and factorials.

Display programming is extremely versatile on the 1500 as each one of the 7 by 156 Liquid Crystal squares making up the display may be addressed via the GCursor and GPrint commands. GCursor specifies the relevant column and GPrint one of the 156 possible combinations of activated squares in that column. Graphic design, though, is more flexible on the printer available with the CE-150 interface. This device has a rotatable printing head containing four ball pens leaving the user with a choice of four different colours. A range of different character sizes are available, although the 58mm. width of paper means that program listings in large character sizes are nearly incomprehensible.

The user has almost complete control over the position and direction of movement of the printer head with respect to the paper hence anything from biorhythm graphs and pie charts to tulips and daisies may be drawn. One point to note is the advice on replacing the ball points in their case after use lest they dry out. Ignore this at your peril, as did your intrepid reviewer with inevitable results. Still, it is a small price to pay for getting away from the hole burning tactics of other printers.

The CE-150 interface comes with a cassette attachment too — all that is required is a reasonable quality recorder with Ear, Mic and Remote jacks. The software allows for the saving and recalling of programs and data on tape as well as the Chaining of programs too large to fit in the 1500's memory. I had trouble loading on to the cassette.

The available cassette software is at present limited to one package of 15 useful mathematical programs. More are promised. The computer comes equipped with instruction and applications manuals. Much attention has been paid to the instruction manual in an attempt not to scare off the first-time user. The first half of the manual is condescending — "Pressing this key will cause the sleeping electronic genie to awaken (don't expect a puff of smoke!)" — and the second half is a trifle terse. This is still one of the best guidance books I have seen. The applications manual contains 52 programs, many with plotting routines, many interesting.

There is no doubt that the PC-1500 is a formidable machine. I started off as a sceptic about pocket computers programmable in Basic. A great deal of thought has gone into the product — even nice little touches such as providing a holder on the underneath of the printer for the detachable cover which hides the multi-pin connector for the 1500.

Hopefully the micro industry will stand up and take note of the innovations which Sharp has brought with it from its calculator experience. It is a very quick housekeeper, almost keeping up with the lightning Casio calculators which have much less of an operating system to worry about. The retail price of £169.95 for the 1500 and £149.95 for the CE-150, though, must put the machine between two stools. Calculator afficionados will find this expensive and probably scorn the Basic. The micro user will probably feel that he is going down market in spite of the fact that this looks a very well constructed machine.

I can only say that I look forward to the future peripherals that are promised with the 1500 and that it is a significant advance for the pocket computer. ■

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Comparison table.

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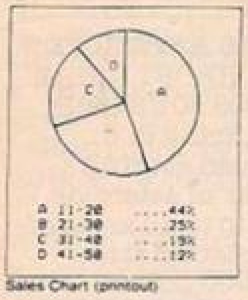


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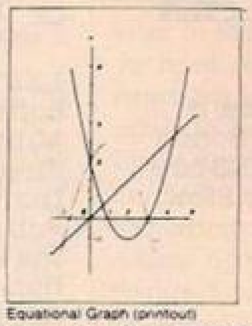
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Sharp 1500 information ☐ MiCROL 1500 information ☐

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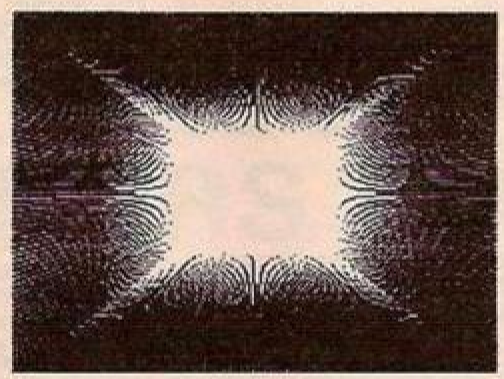
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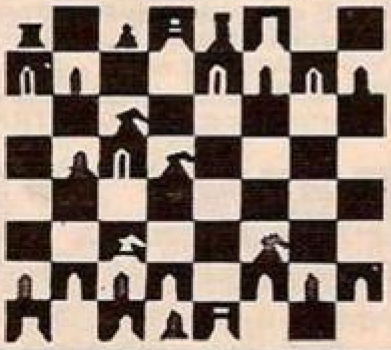
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Plotter-planner

Paul Newman,
Leiston,
Suffolk.

ZX-81

THIS ROUTINE enables a complex plot to be developed, tested, corrected and stored as a string for subsequent inclusion in another program. It includes the segment of 12 lines that are used in the main program to Plot the data. When used in conjunction with one of the plotter-planner pads currently available, a complex plot can be set up and tested in a very short time.

Plot-data can be stored as three numbers; fixed point, moving point, moving point. In this method the following rules apply:

- Data is stored as the character whose code is the co-ordinates' value.
- The first point in each group of three is the fixed point.
- If the fixed point is the X co-ordinate, then 128 is added to the character code to denote this fact.

The routine is started by Goto 1000, where the data-string variable E$ is initialised. Line 1020 reminds you of the options available and asks for the fixed co-ordinate. The options available are as follows:

- Xn/Yn — for X or Y fixed point, n is its value, e.g., X7.
- T — to test the plot so far.
- N — to start afresh.
- E — to end program.

The first option leads to the fixed point being evaluated at line 1080 and error-checked. Line 1230 is a non-jumping substitute for Pause. Line 1110 evaluates P$ as X if Y was the fixed point and vice versa. The moving points are entered and printed at lines 1120 to 1150, and lines 1155 to 1165 ensure that the data just entered can be forgotten if any key other than C is pressed.

Line 1175 evaluates M1 as 63 if entering X-values and 43 for Y-values. Line 1180 error-checks the values entered. On passing all validation, the data entered is concatenated into E$ at line 1190. The screen is cleared and prompts returned as before.

In the second option, line 1040 prevents plotting a null string of data and passes control to the plot routine at line 500. Line 505 preserves the data and line 510 jumps on the value of the first data-slice — line 520 for Y as the fixed point, line 560 for X. The Step constructions in lines 520 and 560 allow the data values to be in ascending or descending order. Line 550 truncates the temporary data B$, and line 560 jumps to 510 if more data is present, 630 otherwise.

Line 630 is the jump out for the Unplot feature. Lines 635 to 665 cause instructions to be placed on line 23 of the screen. If U is pressed, the user is instructed to wait in line 1320. Lines 1325 and 1330 Poke the Unplot instruction directly into the program in lines 530 and 590.

The data string B$ is set to the last three data values in E$, and the plot routine is entered at line 510 — this time to unplot the last-entered data. The exit at line 630 results in lines 1350 and 1360 Poking Plot back into the program. E$ is truncated in line 1370. A jump to line 635 will give the user the chance of continuing or pressing U to unplot again.

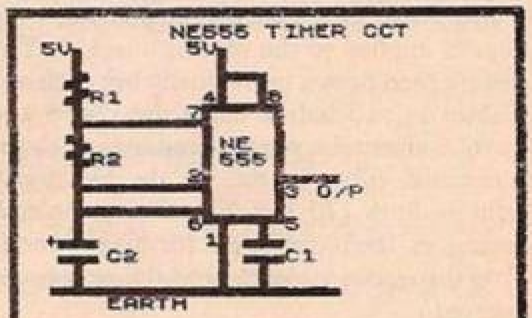
With the third option, entering N will cause the data string E$ to be cleared and the program resumes at line 1020. The fourth option simply stops the program. E$ will contain any data set into it.

Lines 500 to 610 form the plotter routine which should be included in your main program. You may store as many strings as you like — simply point the routine at the right one and Gosub 500.

Note that altering the program as listed above line 600 will change the addresses of the Plot instructions in the program. Bear this in mind when customising this for your own purposes and if using the Unplot feature as part of any main program.

The routine will not cater for diagonal plots — you may care to develop this. It may be more suitable for some purposes to Poke the plot data into a Rem at the top of the routine. You could thus store the data in a visible form rather than an invisible string which will, of course, be cleared by Run.

An example plot.




```
500 CLS
505 LET B$=E$
510 GOTO 520+60*(CODE B$(1)>=12
8)
520 FOR J=CODE B$(2) TO CODE B$
(3) STEP SGN (CODE B$(3)-CODE B$
(2))+1*(B$(2)=B$(3))
530 PLOT J,CODE B$(1)
540 NEXT J
550 LET B$=B$(4 TO )
560 GOTO 510+120*(B$="")
580 FOR J=CODE B$(2) TO CODE B$
(3) STEP SGN (CODE B$(3)-CODE B$
(2))+1*(B$(2)=B$(3))
590 PLOT CODE B$(1)-128,J
600 NEXT J
610 GOTO 550
630 IF R=1 THEN RETURN
635 POKE 16416,0
640 PRINT AT 23,0;"""U"" TO UNP
LOT,OR ANY KEY"
650 POKE 16416,2
660 IF INKEY$="" THEN GOTO 660
665 IF INKEY$="U" THEN GOTO 131
5
670 GOTO 1010
999 REM PLOTTER PLANNER
1000 LET E$=""
1010 CLS
1015 LET R=0
1020 PRINT AT 8,0;"PLOTTER PLANN
ER  (X/Y,T,N,E)"
1025 PRINT AT 10,0;"FIXED CO-ORD
INATE [illegible]";
1030 INPUT C$
1035 IF C$="" THEN GOTO 1030
1040 IF C$(1)="T" THEN GOTO 500+
510*(E$="")
1045 IF C$(1)="N" THEN GOTO 1000
1050 IF C$(1)="E" THEN STOP
1060 IF NOT (C$(1)="X" OR C$(1)=
"Y") THEN GOTO 1010
1065 LET D$=C$
1070 LET M1=43+20*(D$(1)="X")
1080 LET FP=VAL D$(2 TO )
1085 IF FP<0 OR FP>M1 THEN GOTO
1220
1100 PRINT AT 10,16;D$;"      "
1110 LET P$=CHR$ (61+1*(D$(1)="X
"))
1115 PRINT ,,P$;"1  ";
1120 INPUT P1
1130 PRINT P1;"  ";P$;"2 ";
1140 INPUT P2
1150 PRINT P2
1155 PRINT ,,"""C"" IF OK",,"ANY
 OTHER TO RE-DO"
1160 IF INKEY$="" THEN GOTO 1160
1165 IF NOT INKEY$="C" THEN GOTO
 1010
1175 LET M1=43+20*(D$(1)="Y")
1180 IF P1<0 OR P2<0 OR P1>M1 OR
 P2>M1 THEN GOTO 1250
1190 LET E$=E$+CHR$ (FP+128*(D$(
1)="X"))+CHR$ P1+CHR$ P2
1210 GOTO 1010
1220 PRINT ,,,"**FIXED POINTS WR
ONG FOR ";D$(1)
1230 LET L=RND**RND**RND
1240 GOTO 1010
1250 PRINT ,,"**MOVING POINTS WR
ONG FOR ";D$(1)
1260 GOTO 1230
```

(continued on next page)

(continued from previous page)

```
1315 POKE 16418,0
1320 PRINT AT 23,0;">>>> WAIT <<
<<"
1325 POKE 16675,252
1330 POKE 16652,252
1332 LET R=1
1335 LET B$=E$(LEN E$-2 TO LEN E
$)
1340 GOSUB 510
1350 POKE 16675,246
1360 POKE 16652,246
1370 LET E$=E$( TO LEN E$-3)
1390 GOTO 635
```

Voyager views

G E Malpas,
Little Stoke,
Bristol.

BBC

MY PROGRAM simulates the view from Nasa's Voyager spacecraft on its approach to Saturn. It will run on both models of the BBC Microcomputer and demonstrates the high-resolution graphics and some of the plotting capabilities of the machine.

The first part of the program at subroutine 390 describes the program; note the use of double-height teletext characters using Chr$ (141). Then the following data is read from the data file: R, the radius of the planet; M and N, the location of the planet on the screen; Inc, the angle of the rings; and finally Comp, the obliqueness of the rings.

Using this data the planet is drawn but invisibly using the VDU 19 command in line 50 and when the drawing is complete the colour is applied to the plot in line 110. The rings are then drawn individually but each one is drawn in two halves using the Plot 5 and Plot 6 commands which produces a three-dimensional effect by making the plot transparent — lines 170 and 200. The completed drawing is then displayed for five seconds before the screen is cleared and the next frame is plotted.

The data supplied produces eight frames and shows a flight towards the planet, flying over the pole and then looking down through the ring structure. The data could easily be altered to produce different flight paths.

Apart from showing the graphics capability of the BBC machine the program could be used in schools for teaching astronomy or could be used as the background for a game. However, the main problem with the program is that each frame takes about one minute to draw so it could hardly be described as animated motion.

```
1 REM -VOYAGER MISSION-
2 REM BY G. MALPAS  MAY 1982
10 GOSUB 390
20 MODE 4
30 READ R,M,N,INC,COMP
40 IF R=9999 THEN 270
50 VDU 19,1,0,0,0,0
60 MOVE M,N+R
70 FOR A=0 TO 360 STEP 5
80 MOVE M,N+R
90 PLOT 85,SIN(RAD(A))*R+M,COS(RAD(A))*R+N
100 NEXT A
110 VDU 19,1,7,0,0,0
120 FOR X=R*1.2 TO R*2.5 STEP 0.06
130 IF X>R*1.4 AND X<R*1.6 THEN 220
140 IF X>R*2 AND X<R*2.2 THEN 220
150 FOR Y=0 TO 180 STEP 10
160 IF Y=0 MOVE SIN(RAD(Y+INC))*X+M, X/COMP+N
170 PLOT 6, SIN(RAD(Y+INC))*X+N, COS(RAD(Y))*X/COMP+N
180 NEXT Y
190 FOR Y2=180 TO 360 STEP 10
200 PLOT 5, SIN(RAD(Y2+INC))*X+M, COS(RAD(Y2))*X/COMP+N
210 NEXT Y2
220 NEXT X
230 NOW=TIME
240 REPEAT
250 UNTIL TIME=NOW+500
260 CLG:GOTO 20
270 MODE 7:P.TAB(12,12) CHR$(141) "END OF MISSION"
280 P.TAB(12,13) CHR$(141) "END OF MISSION"
290 END
300 DATA 100,640,512,45,2
310 DATA 150,640,512,45,2
320 DATA 200,640,512,45,2
330 DATA 250,640,384,45,2
340 DATA 300,640,256,45,2
350 DATA 350,640,128,20,1.5
360 DATA 450,640,100,10,1.2
370 DATA 550,640,0,0,1
380 DATA 9999,0,0,0,0
390 MODE 7
400 P.TAB(15,5) CHR$(141)"VOYAGER"
410 P.TAB(15,6) CHR$(141)"VOYAGER"
420 P.TAB(15,8) CHR$(141)"MISSION"
430 P.TAB(15,9) CHR$(141)"MISSION"
440 P.TAB(5,12) "A series of computer generated"
450 P.TAB(5,14) "stills from the Voyager mission"
460 P.TAB(5,16) "to Saturn for the BBC computer"
470 NOW=TIME
480 REPEAT
490 UNTIL TIME=NOW+1000
500 RETURN
```

As you like it

Roy Kay,
New Ferry,
Merseyside.

ZX-81

IF LIKE ME, you enjoy watching your ZX-81 create random patterns, this simple little program will interest you. If works on the unexpanded machine. Feed in any combination of graphics and/or other characters making 10 characters in all.

I find that a combination of just two or three graphic symbols seem to produce the most interesting patterns.

```
10 DIM A$(10)
20 INPUT A$
30 FOR J = 1 TO 640
40 LET X = INT(RND*10)+1
50 PRINT A$(X);
60 NEXT J
```

Alien attack

J Jones,
Cardiff.

ZX-81

THE OBJECT of Alien Attack is to try and shoot down the randomly moving aliens without being invaded. You have three lives. The keys used are the cursor keys to move left and right and the shift key to fire. If you shoot all 128 aliens, another batch appears. The R key starts a new game.

To input the program type in the Rem statement in line 1. Note that this should not be typed as it appears but as a series of characters. Type in the hexadecimal loader, program 3, and run it.

Now type in the machine code but missing out the first column as this is just the address at which it is stored. You can input several pairs of figures at a time before hitting Newline. Read the numbers across, not down the columns. For those who have not encountered machine code before these are hexadecimal

numbers — see page 155 of the ZX-81 manual.

Enter lines 100 onwards of the game listing and Save this several times. Type Run 100.

If it does not work then check your Basic listing. If this is not at fault then enter program 4, substituting the addresses between which you wish to check for start and end. Type Run 9000 and check that this agrees with my listing of machine code. You can correct any mistakes by changing the value for A in line 10 to the offending address and entering the correct figures. I would recommend Saving this several times again before testing.

If everything is satisfactory, load the program from the cassette — to reset the high score which becomes part of the program — and delete lines 11 to 17. Do not delete line 10 — this will cause a system crash. Enter lines 10 to 40 of the game program. Start the cassette recorder recording and type Run.

The program will Save itself. If you wish to break in you will have to do so at the end of the game or losing a life as this is the only time that the break key is operative.

```
   1 REM <512 CHARACTERS>
  10 PRINT AT 5,5;"ALIEN ATTACK,
J.JONES";TAB 5;"[redacted]"
  20 SAVE "ALIEN ATTACK"
  30 INPUT A$
  40 PRINT AT 0,0;
 100 RAND
 110 LET L=USR 16540
 120 LET L=RND**RND**RND
 130 LET L=USR 16576
 140 LET L=RND**RND**RND
 150 LET L=USR 16576
 160 PRINT AT 11,11;"GAME OVER";
AT 11,11;"GAME OVER";AT 0,0;
 170 IF INKEY$<>"R" THEN GOTO 16
0
 180 GOTO 100

MACHINE CODE

16514 01 00 FF FF 21 00 DF FF
16522 20 00 22 00 E0 FF DE FF
16530 E1 7E 23 E5 FE FF C8 D7
16538 18 F6 CD 92 40 38 28 34
16546 37 2A 00 1C 1C 1C 1C 1C
16554 1C 00 00 2D 38 28 34 37
16562 2A 00 1C 1C 1C 1C 1C 1C
16570 00 00 00 00 00 FF FD 36
16578 22 00 01 C0 02 2A 0C 40
16586 11 21 00 19 23 7E FE 76
16594 28 FA 36 80 0B 78 B1 20
16602 F3 23 23 06 20 36 88 23
16610 10 FB 11 3F 00 AF ED 52
16618 06 04 3E 89 77 23 77 23
16626 77 23 77 23 23 23 23 23
16634 10 F2 2A 0C 40 11 09 01
16642 19 06 80 23 7E FE 76 28
16650 FA 36 B4 10 F6 2A 0C 40
16658 11 07 03 19 22 3C 40 36
16666 15 3E 80 32 3E 40 2A 0C
16674 40 11 21 00 19 01 E0 02
16682 23 7E FE B4 20 2F E5 2A
16690 32 40 54 5D 29 29 19 29
16698 29 29 19 22 32 40 7C E6
16706 0E C6 82 6F 26 40 5E 23
16714 56 E1 19 7E FE 15 C8 FE
16722 88 C8 FE 80 20 07 36 9C
16730 AF ED 52 36 80 0B 78 B1
16738 20 C6 2A 0C 40 01 18 03
16746 23 7E FE 9C 20 02 36 B4
16754 0B FE 08 20 02 36 80 78
16762 B1 20 ED 06 02 C5 CD BB
16770 02 7D FE FF 28 28 FE F7
16778 28 13 2A 3C 40 23 7E FE
16786 76 28 1B 36 15 22 3C 40
16794 2B 36 85 18 11 2A 3C 40
16802 2B 7E FE 76 28 08 22 3C
16810 40 36 15 23 36 88 C1 10
16818 CC CD BB 02 CB 44 20 15
16826 2A 3C 40 11 DF FF 19 7E
16834 FE B4 20 07 E5 CD 03 42
16842 E1 18 02 36 9B 2A 0C 40
16850 01 00 03 23 7E FE 76 28
16858 FA FE 9B 20 1C 36 80 11
16866 DF FF 19 7E FE B4 20 07
16874 E5 CD 03 42 E1 18 06 FE
16882 80 20 02 36 9B 11 21 00
16890 19 0B 78 B1 20 D5 00 00
16898 C3 1E 41 2A 0C 40 11 0C
16906 00 19 7E 3C FE 26 20 05
16914 36 1C 2B 18 F5 77 D1 E1
16922 E5 D5 35 08 C5 06 06 2A
16930 0C 40 11 07 00 19 11 E4
16938 40 1A 4E B9 38 06 20 26
16946 23 13 10 F5 2A 0C 40 11
16954 07 00 19 54 5D 01 0F 00
16962 09 EB 01 06 00 ED B0 2A
16970 0C 40 11 07 00 19 11 B4
16978 40 01 06 00 ED B0 C1 3A
16986 3E 40 3D 32 3E 40 C0 E1
16994 E1 C3 C0 40 00 1C 1C 1C
```

```
LISTING 3

   1 REM <FOR MACHINE CODE>
  10 LET A=16514
  11 LET A$=""
  12 IF A$<>"" THEN INPUT A$
  13 PRINT A$
  14 POKE A,CODE A$*16+CODE A$(2
)-476
  15 LET A$=A$(3 TO )
  16 LET A=A+1
  17 GOTO 12
```

```
LISTING 4

9000 FOR N=START TO END STEP 8
9010 PRINT TAB 0;N;
9020 FOR M=N TO N+7
9030 LET L=PEEK M
9040 PRINT " ";CHR$ (28+INT (L/1
6));CHR$ (28+L-16*INT (L/16));
9050 NEXT M
9060 NEXT N
```

Ragtime RAM

Ian Greenshields,
Emsworth,
Hampshire.

VIC-20

THE PROGRAM PLAYS a ragtime tune in two-part harmony on the unexpanded Vic-20. The music is stored in the Data statements which are read into the integer variable arrays D1%, D2%, P1%, P2%. The information contained is as follows:

D1% lines 100 to 120 — duration of bass notes
D2% lines 200 to 220 — duration of treble notes
P1% lines 300 to 330 — pitch of bass notes
P2% lines 400 to 440 — pitch of treble notes.

Lines 18 to 70 play the tune while allowing independent control over the duration of each of treble and bass notes. Integer variables must be used on the 3.5K Vic as these use less memory than floating-point variables.

The listing for an alternative tune plays a traditional baroque air. The programs should be easily convertible for three-part harmonies by means of the third sound voice although the memory limitation of the unexpanded Vic will make the maximum length of the music much shorter.

```
1 REM  **    RAGTIME FOR 3.5K VIC20
2 REM  **(C) IAN GREENSHIELDS
3 REM  ** &  STEVE TUCKER
5 DIM D1%(110),D2%(200),P1%(110),P2%(200)
6 X=0
7 READ D1%(X):IF D1%(X)=-1 THEN 9
8 X=X+1:GOTO 7
9 Y=0
10 READ D2%(Y):IF D2%(Y)=-1 THEN 12
11 Y=Y+1:GOTO 10
12 X=0
13 READ P1%(X):IF P1%(X)=0 THEN 15
14 X=X+1:GOTO 13
15 Y=0
16 READ P2%(Y):IF P2%(Y)=0 THEN 18
17 Y=Y+1:GOTO 16
18 POKE 36878,10:S2=36875:S3=36876
19 X=0:Y=0
20 IF D1%(X)<=0 THEN X=X+1
30 IF D2%(Y)<=0 THEN Y=Y+1
40 POKE S2,P1%(X):POKE S3,P2%(Y)
50 D1%(X)=(D1%(X))-1:D2%(Y)=(D2%(Y))-1
55 IF D2%(X)=-1 THEN 70
60 GOTO 20
70 END
100 DATA 8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8
110 DATA 8,24,8,4,8,4,4,4,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,8
120 DATA 8,8,8,8,8,8,8,8,8,8,8,8,8,8,8,-1
200 DATA 4,8,4,4,8,4,8,4,8,12,4,4,4,4,4,8,4,4,4,4,8,12,8,4,4,4,8,4,8,4,8,12
210 DATA 8,8,8,8,8,4,8,4,4,4,8,4,4,4,8,4,8,4,8,12,4,4,4,4,4,8,4,4,4,4
220 DATA 8,12,4,12,4,12,4,12,8,8,8,8,4,12,36,-1
300 DATA 183,201,183,201,183,201,183,201,175,201,175,201,175,201,175,201,183,20
1
```

(continued on page 85)

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(continued from page 83)

```
 310 DATA 183.201.183.201.183.201.175.100.221.221.215.147.159.175.167.201.183.20
1.183
 320 DATA 201.183.201.175.201.175.201.175.201.175.201.195.215.199.221.175.201.15
9.207
 330 DATA 183.207.167.201.175.201.175.201.0
 400 DATA 100.212.201.207.212.201.212.207.201.183.100.187.191.201.207.215.201.20
7.201
 410 DATA 207.215.207.100.212.201.207.212.201.212.207.201.183.100.215.207.201.19
1.191
 420 DATA 191.147.159.175.167.212.201.207.212.201.212.207.201.183.100.187.191.20
1.207
 430 DATA 215.201.207.201.207.215.207.100.195.100.199.100.215.207.201.183.215
 440 DATA 100.212.215.0
READY.


 50 REM -- DATA STATEMENTS FOR ALTERNATIVE TUNE
 100 DATA 6.6.12.12.12.12.12.12.12.12.12.12.12.12.12.12.6.6.6.6.12.12.12.12.12.1
2.12.12
 110 DATA [illegible].12.36.12.12.12.12.12.12.12.12.12.12.12.12.12.6.6.6.5.12.12.12
.12.12
 120 DATA 12.12.12.12.12.12.12.12.12.6.6.6.6.12.12.12.12.12.12.12.12.12.12.12.12
.12.12
 130 DATA 18.6.6.6.12.6.6.12.6.6.12.6.6.12.12.12.12.12.24.36.-1
 200 DATA 6.6.12.6.6.12.6.6.12.6.6.12.6.6.12.6.6.12.6.6.6.6.6.6.12.6.6.12.6.6.12
.6.6
 210 DATA 12.6.6.12.6.6.12.6.6.3.3.3.3.6.6.36.6.6.12.6.6.12.6.6.12.6.6.12.6.6.12
.6.6
 220 DATA 12.6.6.36.6.6.12.6.6.12.6.6.12.6.6.12.6.6.12.6.6.3.3.3.3.6.6.36.6.6.12
.6.6
 230 DATA 12.6.6.12.6.6.12.6.6.12.6.6.12.6.6.12.24.6.6.12.6.6.12.6.6.12.6.6.12.6
.6
 240 DATA 12.6.6.3.3.3.3.6.6.36.-1
 300 DATA 175.167.159.183.191.183.175.167.159.167.175.183.191.183.175.191.159.16
7
 310 DATA 175.167.159.183.191.183.175.167.159.167.175.195.201.147.175.175.167.14
7.175
 320 DATA 191.195.179.183.201.207.183.207.159.183.191.183.175.167.147.175.191.19
5
 330 DATA 179.183.199.201.187.191.207.212.167.191.187.191.199.203.191.207.201.19
9
 340 DATA 183.201.195.191.175.195.191.183.167.191.195.191.183.179.183.207.167.17
5
 350 DATA 203.207.167.199.203.159.183.191.183.191.159.0
 400 DATA 207.212.215.212.207.203.207.212.191.199.203.207.201.195.191.183.175.16
7.175
 410 DATA 183.191.183.175.167.159.207.212.215.212.207.203.207.212.191.199.203.20
7.203
 420 DATA 195.191.183.175.167.175.167.175.167.175.175.191.175.201.183.195.191.21
5.201
 430 DATA 207.191.201.195.191.183.179.183.191.195.191.183.183.201.183.191.215.20
1.207
 440 DATA 191.201.195.219.207.212.199.207.201.199.191.187.191.187.191.187.191.19
1.223
 450 DATA 212.217.212.207.219.207.215.212.207.201.215.201.209.207.219.207.212.19
9.207
 460 DATA 203.191.207.191.195.201.183.191.195.175.183.191.212.175.212.207.151.15
9.167
 470 DATA 167.175.167.175.167.159.159.0
READY.
```

Course and time

Chester Watson,
Ventnor,
Isle of Wight.

ZX-81

THIS IS a navigational aid for yachtsmen and small-boat sailors, and fits in the unexpanded ZX-81. Because the ZX-81 may be adversely affected by a deluge of sea water, I have devised a navigational exercise for use at home before setting out.

The compass course to steer and the time taken are displayed, and all the courses for a day's sailing may be planned without the need for the usual geometrical plotting on the chart. Press Run then enter the inputs. The screen will display the course and time taken. Press Run before each new set of five inputs is entered. No correction has been made for true north or leeway.

- Input A is the compass course required in degrees.
- Input B is the direction of flow of the tide in degrees.
- Input C is the speed of the boat in knots.
- Input D is the speed of the tide in knots.
- Input E is the course distance in nautical miles.

This program was conceived upside down while applying antifouling — is there any chance of a waterproof Spectrum for mariners?

```
5    PRINT "STEER"; TAB7; "HOURS"; TAB 15;"MINUTES"
10   INPUT A
20   INPUT B
30   INPUT C
40   INPUT D
50   INPUT E
60   IF B<A THEN GOTO 90
70   LET S = B-A
80   GOTO 100
90   LET S = A-B
100  IF S<180 THEN GOTO 120
110  LET S=360-S
120  LET H= (ASN((D*SIN(S/180 * PI))/C))/PI*180
130  IF B<A AND A-B <180 THEN GOTO 170
140  IF A<B AND B-A >180 THEN GOTO 170
150  LET I = INT (A-H)
160  GOTO 200
170  LET I = INT (A+H)
180  IF I<360 THEN GOTO 200
190  LET I=I-360
200  IF I>0 THEN GOTO 220
210  LET I=I+360
220  LET J=((COS(H/180*PI))*C)+((COS(S/180*PI))*D)
230  LET K=(E/J)*60
240  LET L=INT(K/60)
250  LET M=INT K-(60*L)
260  PRINT AT 3,1;I;TAB9;L;TAB 17;M;
```

Bridge too far

Stuart Maclaren,
Bradford,
West Yorkshire.

PET

THE AIM OF this game is to ensure that the wolf, goat and cabbage all cross to the other side of the river intact. The problem is that you can only take one at a time, but if you leave the wolf and the goat by themselves, the wolf will eat the goat. Likewise, the goat will eat the cabbage if given the slightest chance.

There are only two solutions and the game is good for parties or impressing friends. Although run on the Pet, it should work on any other computer. Lines 1 and 51 are to clear the screen.

```
1 PRINT"■"
3 B=0
4 G$="MAN        "
5 A=1111
6 A$="GOAT       "
7 C$="WOLF       "
8 E$="CABBAGE"
9 B$="           "
10 D$="          "
11 F$="          "
12 H$="          "
13 GOSUB 1500
14 PRINT"MOVING LEFT TO RIGHT-MAN AND"
15 GOSUB 20
16 GOTO 100
20 PRINT"                  "
21 PRINT"          0-NOTHING"
25 PRINT"          1-GOAT"
30 PRINT"         10-WOLF"
40 PRINT"        100-CABBAGE"
50 INPUT M
51 PRINT"■"
60 RETURN
100 A=A-M-1000
110 B=B+M+1000
115 IF A=11 THEN 170
116 IF A= 101 THEN 170
```

(continued on next page)

(continued from previous page)

```
117 IF A=111 THEN 170
120 GOTO 190
170 PRINT"      ▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒"
171 PRINT"      START AGAIN     "
172 PRINT"      ▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒"
180 GOTO 3
190 IF M=0 THEN 330
195 IF M=1 THEN 250
200 IF M=10 THEN 280
210 IF M=100 THEN 310
220 GOTO 170
250 A$="          "
260 B$="GOAT      "
270 GOTO 330
280 C$="          "
290 D$="WOLF      "
300 GOTO 330
310 E$="          "
320 F$="CABBAGE"
330 G$="          "
340 H$="MAN       "
350 IF B=1111 THEN 700
355 GOSUB 1500
360 PRINT"MOVING RIGHT TO LEFT-MAN AND"
370 GOSUB 20
380 A=A+M+1000
390 B=B-M-1000
395 IF B=11 THEN 170
396 IF B=101 THEN 170
400 IF B=111 THEN 170
470 IFM=0 THEN 580
475 IF M=1 THEN 500
480 IF M=10 THEN 530
490 IF M=100 THEN 560
495 GOTO 170
500 A$="GOAT      "
510 B$="          "
520 GOTO 580
530 C$="WOLF      "
540 D$="          "
550 GOTO 580
560 LET E$="CABBAGE"
570 F$="          "
580 G$="MAN       "
590 H$="          "
600 GOSUB 1500
610 GOTO 14
700 PRINT"      ▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒"
701 PRINT"      WELL DONE KID  "
705 PRINT"      ▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒ "
710 PRINT
720 GOSUB 1500
730 END
1500 PRINT
1501 PRINT"         ▒    ▒   "
1502 PRINT" LEFT    ▒    ▒   RIGHT"
1506 PRINT"         ▒    ▒   "
1510 PRINTA$" ▒    ▒ "B$
1520 PRINT"         ▒    ▒   "
1530 PRINTC$" ▒    ▒ "D$
1540 PRINT"         ▒    ▒   "
1550 PRINTE$" ▒    ▒ "F$
1560 PRINT"         ▒    ▒   "
1570 PRINTG$" ▒    ▒ "H$
1580 PRINT"         ▒    ▒   "
1585 PRINT
1590 RETURN
```

Verse and worse

R Newton,
Braintree,
Essex.

ATOM

WHEN RUN, the program will ask for a number of lines; this is how many lines the poem will have. The program then proceeds to write a poem, using a definition of the English language which can be decoded into Backus-Naur Form as follows:

(sentence) = :: (S2)/(S2)/(conjunction) (S2)
(conjunction) = :: after/before/then/but/and
(S2) = :: (NP) (VP)
(NP) = :: (CN)/(NPro)/(CN) of (CN)
(CN) = :: (article) (noun)/(article) (Adjg) (noun)
(Adjg) = :: (Adjective), (Adjg)/(Adjective)
(VP) = :: (Verb) (RNP)
(RNP) = :: (CRN)/(CN) of (CRN)
(CRN) = :: (article) (noun)/(article)(Adjg)(noun)/(PS)(noun)/(PS)(Adjg)(noun)
(NPro) = :: I/you/he/she/it/we/they
(PS) = :: his/her/my/our/your/its/their
(article) = :: a/the

The data at the end of the program defines the words for adjective, noun, verb, possessives, and so on, and the program simply chooses a word from this list and prints it out.

Connected with the BNF definition, here are the subroutines which produce each word or phrase:

200-206 (CN)	260-266 (CRN)	500-530 search for and print word
220-226 (Adgj)	280-286 (title and author)	
240-250 (noun)	300 (NPro)	

I have left spaces in the labels used, so that more words may be inserted simply by adding a new line and label with seven new words, all separated by commas. You will also need to change the randomiser by adding one for each new line as follows:

Type of word	Empty labels	Change
Adjective	e, f	220 (value of 'F') 224 (value of 'F')
Verb	m, n, o, p	50 (value of 'B')
Noun	w, x, y	240 (value of 'C')

Also, if you are not happy with this version of the English language, it should not be too difficult to modify it to meet your personal requirements.

```
10   P.$12"ATOM POEMS"''
15   DIM A10;N=7;D=13;X=?18*256;Q=X
20   G.80
30   B=A.R.%3
32   IFB Y=CH"a";GOS.500
40   B=A.R.%7
42   IFB<4 GOS.200
44   IFB=3 P." OF ";GOS.200
46   IFB>3 GOS.300
50   B=A.R.%4
52   Y=CH"i"+B;GOS.500
60   B=A.R.%4
62   IFB GOS.200;P."OF"
64   GOS.260;    ;R.
80   IN."NUMBER OF LINES"Z
81   GOS.280;F.R=1 TO Z
84   GOS.30;N.R
90   IN.''"ANOTHER"$A
92   IF?A=CH"Y" G.10
94   END
200  Y=CH"b"; GOS.500
202  C=A.R.%2
204  IFC GOS.220
206  GOS.240;R.
220  C=A.R.%4;F=A.R.%2
222  Y=CH"c"+F;GOS.500
224  IFC F=A.R.%2;Y=CH"c"+F;P.",";GOS.500
226  R.
240  C=A.R.%6
242  Y=CH"α"+C;GOS.500;R.
260  E=A.R.%4
261  IFE<2 Y=CH"b";GOS.500
262  IFE>1 Y=CH"h";GOS.500
264  IFE%2 GOS.220
266  GOS.240;R.
280  B=A.R.%2;X=Q;P.$12
282  IFB-0 Y=CH"s";GOS.500
284  IFB GOS.260
286  Y=CH"z";P.''" BY ";GOS.500;R.
300  Y=CH"s";GOS.500;R.
500  DO DO X=X+1;U.?X=D;U.X?3=Y
505  X=X+3;Y=CH","
510  F.P=1 TO A.R.%N+1
515  DO X=X+1;IF?X=D X=X+3
520  U.?X=Y;N.P
525  DO X=X+1;P.$?X
530  U.X?1=Y OR X?1=D;P." "; Q=X;R.
```

(continued on page 89)

PROGRAMPOWERPROGRAMPOWER

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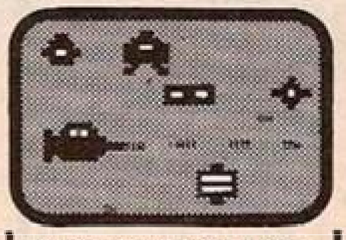




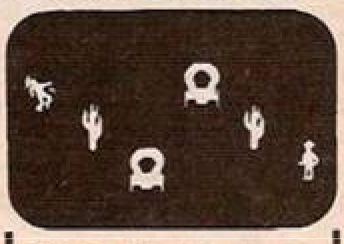
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(continued from page 86)

```
1000a,after,before,then,but,and,but,and
2000b,a,a,a,the,the,the,the
3000c,kind,lazy,bizarre,delerious,aghast,happy,absurd
3200d,existentialist,insane,primeval,enthusiastic,idle
3300,psychotic,terrified
4000gI,you,he,she,it,we,they
5000h,my,your,his,her,its,our,their
6000i,drowned,calcified,gazed at,hugged,abducted,ate,made
6200j,protected,fought,saw,murdered,shotat
6300,infuriated,confused
6400k,despised,tortured,worshipped,devoured,faced
6500,abhored,hated
6600l,preached at,whispered to, threw, rebuffed
6700,shouted at, allowed,abjured
7000q,hand,goat,beast,priest,aegina,agent,serpent
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7800u,aesop,frog,dog,log,hog,mouse,grouse
8000v,house,mind,hind,body
8100,phsicist,anarchist
9000z,FLO P.DISK,MEG A.BYTE, MIKE R.O.CHIP
9100,C.P.EWE,AKE O'NATUM,ANONYMOUS
9200,"TELLY" TYPE
```

Multicolour

Simon O'Leary, Rickmansworth, Hertfordshire.

BBC

MULTICOLOUR is a short yet very effective program for the model A and B BBC Micro. On a colour television in modes 1, 2 and 5, several new colours appear to be added to the standard palette.

The program prints lines radiating from the centre in different colours and certain combinations of these produce new colours and different shades of the colours such as orange, pink and mauve. In mode 2, up to about six shades of the colours can be viewed. This technique of colour generation will be important in games as well as other applications.

```
5  REM MULTICOLOUR: S.J. O'LEARY
10 FOR K=0 TO 5
20 IF K=3 THEN NEXT
30 MODE K
40 FOR J%=1 TO 1000
50 GCOL3,RND(7)
60 MOVERND(1200),RND(1000)
70 DRAW600,500
80 NEXT:NEXT
90 GOTO 10
```

Surrounded

Paul Beadle, Stafford.

ZX-81

THERE IS NO way of winning outright this ZX-81 surround game. The object of the game is to keep moving for as long as possible before you are forced to crash into one of the blocks. To start the game, press Newline. Your position is shown on the map as a star. Three blocks are then placed around you and you must now make your move. You do this by pressing the number corresponding to the direction you have chosen, and then Newline.

An incorrect move will cause the game to stop and your time will be printed. This will also happen when you are unable to move. The program uses the Val function to allow it to fit in 1K of memory. 16K ZX-81 owners must change the 11 in line 240 to 33.

```
  1 REM P.B.
 20 PRINT "SURROUND"
 30 INPUT D$
 40 CLS
100 FOR I=VAL"1" TO VAL "10"
110 PRINT "ten inverse spaces"
120 NEXT I
130 LET Q=PEEK VAL"16396"+ VAL"256" * PEEK VAL
    "16397"+ VAL"1"
140 LET T=VAL"0"
150 LET X=VAL"5"
155 LET Y=X
160 PRINT AT Y,X;"*"
165 FOR I=VAL"1" TO VAL"3"
170 LET A=X+INT(RND*VAL"3")-VAL"1"
175 IF A>VAL"9" OR A<VAL"0" THEN GOTO VAL"170"
180 LET B=Y+INT(RND*VAL"3")-VAL"1"
185 IF B>VAL"9" OR B<VAL"0" THEN GOTO VAL"180"
190 IF A=X AND B=Y THEN GOTO VAL"170"
200 PRINT AT B,A;" (inverse O) "
205 NEXT I
210 INPUT D$
215 IF CODE D$>VAL"36" OR CODE D$<VAL"33" THEN
```

(continued on next page)

(continued from previous page)

```
    GOTO VAL"400"
220 LET V=X+(D$="8")-(D$="5")
230 LET W=Y+(D$="6")-(D$="7")
240 IF PEEK (Q+V+VAL"11"*W)=VAL"180" THEN GOTO
    VAL"400"
250 PRINT AT Y,X;" (inverse space) "
260 LET X=V
270 LET Y=W
280 LET T=T+VAL"1"
290 GOTO VAL"160"
400 CLS
410 PRINT"TIME=";T
420 RUN
```

Sea battle

Lakith Leelasena,
Ilford,
Essex.

BBC

THIS PROGRAM resembles Space Invaders and is suitable for both Model A and B BBC Microcomputers. The player is given three ships and can fire any number of shots from his ship and prevent aeroplanes landing.

When a plane is shot down, the player scores a random number between one and 50. The player loses if all three ships are destroyed or if more than 10 planes land, and the game ends.

The player can move the position of his ship to the left or the right by pressing Z and X respectively; one fires by pressing /. This program includes sound and whenever a ship is destroyed a beep is heard. The program will run in 16K.

```
10  REM AIR SEA BATTLE BY LAKITH LEELASENA
23  CLS:PRINT TAB(0,20) " PRESS ANY KEY WHEN YOU ARE READY...."
26  A$ = GET $
30  CLS:MODE 7
35  FOR P = 0 TO 40 :PRINT TAB (P,21) "-":NEXT P
40  PRINT TAB (0,23) "
50  N = 0: D=0 : E =0 : F= 3 : G =0: R= 0
55  C= RND (36) + 2
60  A = RND (36) + 2: B = 0
70  IF B <> 0 THEN PRINT TAB (A,B-1) " "
80  PRINT TAB (A,B) ; CHR$ (-1); TAB (0,23) "SCORE = ";N
90  SOUND 1,-10,9,3
100 IF D=1 OR D=2 THEN PRINT TAB(0,20) " (40 BLANKS) "
110 D= 0
120 PRINT TAB ( C-1,20) "
130 Z$ = INKEY$ (15)
140 IF Z$ = Z THEN D = 1
150 IF Z$ = X THEN D = 2
151 IF D =1 THEN C = C -1
152 IF D =2 THEN C = C +1
153 IF C < 2 THEN C = 2
154 IF C > 2 THEN C = 39
155 IF Z$ ="/" THEN GOTO 250
160 IF B = 20 AND C = A THEN GOTO 450
190 IF F= 2 THEN PRINT TAB (0,23) "<=> <=>  "
200 IF F = 1 THEN PRINT TAB (0,23)"<=> <=>  "
210 IF F = 0 THEN GOTO 400
212 IF B = 20 THEN PRINT TAB (A, B) ""
215 B = B + 1
220 IF B = 20 THEN R = R + 1
235 IF R > 10 THEN GOTO 430
236 IF B = 21 THEN GOTO 60
240 GOTO 70
250 H = 19
255 PRINT TAB ( C,H) " "
260 J = RND (50)
290 IF H += B AND C =A THEN GOTO 480
300 FOR V = 1 TO 15
310 SOUND 0,-15,4,0
320 NEXT V
325 PRINT TAB (C,H ) " "
340 IF H=0 THEN GOTO 220
350 H =H-1
360 GOTO 255
400 CLS:PRINT:PRINT "YOUR LAST SHIP IS DESTROYED"
410 PRINT ;"YOUR SCORE EQUALS "; N
420 PRINT TAB(0,15) " DO YOU WANT TO PLAY AGAIN"
421 C$ = GET $
422 IF C$= "Y" THEN GOTO 22
425 END
430 CLS: PRINT " MORE THAN TEN PLANES HAVE LANDED": GOTO 400
450 F = F - 1
460 IF F = 0 THEN GOTO 400
465 SOUND 0,-15,0,5
466 PRINT TAB(C-2,20) "      "
470 GOTO 55
480 PRINT TAB (A,B); J
490 FOR T = 1 TO 1000
500 NEXT T
510 PRINT TAB (A,B) "  "
515 N = N+J
520 GOTO 60
530 END
```

In the picture

I S Jones,
Criccieth,
Gwynedd.

ATOM

THIS PROGRAM allows the user to plot a picture on the screen in any of the graphic modes using various keys to draw in different directions. First you are asked to input the graphic mode required, and then the starting position. When this information has been input the screen is set to the required graphics mode and a small dot on the screen shows where the cursor is.

To move upwards press T; downwards, B; to the left, F; to the right, H; diagonally upwards to the left, R; diagonally downwards to the left, V; diagonally upwards to the right, Y; diagonally downwards to the right, N; to cursor without drawing a line, I; to turn the drawing routine on again, O; and to end press E.

```
10  REM PICTURE PLOT
20  PRINT $12," PICTURE PLOT"''
30  INPUT " INPUT GRAPHICS MODE (0-4) ", N
40  INPUT " INPUT STARTING POSITION "'"X :",X,"Y:",Y
50  CLEAR N
60  MOVE X,Y ; DRAW X,Y ; A=X ; B=Y
70  DIM LL(2) , P(-1)
80  PRINT $21
90[
100:LL0 JSR FFE6
110 STA #80
120 RTS
130]
140 DO
150 LINK LL0
160 IF  ?#80=CH"T" THEN Y=Y+1
170 IF  ?#80=CH"B" THEN Y=Y-1
180 IF  ?#80=CH"F" THEN X=X-1
190 IF  ?#80=CH"H" THEN X=X+1
200 IF  ?#80=CH"R" THEN X=X-1 ; Y=Y+1
210 IF  ?#80=CH"V" THEN X=X-1 ; Y=Y-1
220 IF  ?#80=CH"Y" THEN X=X+1 ; Y=Y+1
230 IF  ?#80=CH"N" THEN X=X+1 ; Y=Y-1
240 IF  ?#80=CH"I" THEN I=1
250 IF  ?#80=CH"O" THEN I=0
260 DRAW X,Y
270 IF I=1 THEN PLOT 14,A,B;MOVE X,Y
280 A=X ; B=Y
290 UNTIL ?#80=CH"E"
300 PRINT $6,$12
310 END
```

Scroll roles

Per Nielsen,
Hundested,
Denmark.

ZX-81

OWNERS OF THE 16K ZX-81 will have noticed how slow it can be when using the scroll-function in long programs or in programs with plenty of data. Try the following:

```
10 DIM A(2900)
20 SCROLL
30 PRINT "ZX 81 IS VERY SLOW"
40 GOTO 20
```

Watch how long it takes to print the text in line 30. After running it for a while, break the program and press CLS. Notice the remarkably long time it takes to clear the screen. The reason for these long run-times is that the scroll function does peculiar things to the display file.

My machine-code program is to be used on the 16K ZX-81. It performs the scroll function at speed and also includes a special feature: it can leave a number of top lines unscrolled thus making it possible to have, say, a headline unaffected by the scrolling. To achieve this use Poke 16417,N where N is the number of top lines you want unscrolled. 16417 is one of the unused addresses in the system variables area and is set to zero on power-up.

It is saved together with the program making it possible to include a default value

for N by Poking before you save the program. Do not use the program when the display file is not in the normal 16K mode.

The special display file occurs when:

- You have less than 3.25K of memory.
- You use the normal scroll function — CLS will retrieve normal display.

The program occupies 62 bytes and can be stored anywhere since it uses no absolute jumps. I suggest that it is stored in a Rem statement in line 1. The program can then be called Rand Usr 16514.

```
2A 0C 40              LD HL,(D FILE)    B7          OR A
11 21 00              LD DE,21          ED 52       SBC HL,DE
B7                    OR A              44          LD B,H
ED 52                 SBC HL,DE         4D          LD C,L
3A 21 40              LD A,(4021)       21 21 00    LD HL,21
47                    LD B,A            19          ADD HL,DE
C6 EA                 ADD A,EA          ED B0       LDIR
D8                    RET C             2A 0C 40    LD HL,(D FILE)
04                    INC B             01 B6 02    LD BC,02B6
19           Loop:    ADD HL,DE         09          ADD HL,BC
10 FD                 DJNZ,Loop         22 0E 40    LD(DF CC),HL
23                    INC HL            3E 21       LD A,21
EB                    EX DE,HL          32 39 40    LD (4039),A
21 D7 02              LD HL,02D7        3E 03       LD A,03
ED 4B 0C 40           LD BC,(D FILE)    32 3A 40    LD (403A),A
09                    ADD HL,BC         C9          RET
```

Borderline case

D Clancy,
Wythenshawe,
Manchester.

ZX-81

THIS PROGRAM prints a border round the screen. First type in a Rem statement 47 characters long and then enter the numbers in the second column using the machine-code loader. To use the routine, Poke the code of the character which you wish to be printed into location 16507 and then Rand Usr 16514. A flashing border can be producing by Poking 16507 with a character and then with a space.

```
1 REM (47 characters)
10 FOR N = 16514 TO 16561
20 INPUT U
30 POKE N, U
40 SCROLL
50 PRINT N;" = ";U
60 NEXT N
```

```
MNEMONIC          DEC CODE      HEX CODE     Ld B,21        6,21       06,15
Ld A,(16507)      58,123,64     3A,7B,40     Pop HL         225        E1
Ld HL,(16396)     42,12,64      2A,0C,40     Push HL        229        E5
Ld B,32           6,32          06,20        Ld DE,33       17,33,0    11,21,00
Inc HL            35            23           Inc HL         35         23
Ld (HL),A         119           77           Ld HL,A        119        77
Djnz -4           16,252        10,FC        Add HL,DE      25         19
Ld HL, (16396)    42,12,64      2A,0C,40     Djnz -4        16,252     10,FC
Push HL           229           E5           Ld B,21        6,21       06,15
Ld DE,725         17,213,2      11,D5,02     Pop HL         225        E1
Ad HL,DE          25            19           Dec HL         43         2B
Ld B,32           6,32          06,20        Add HL,DE      25         19
Ld (HL),A         119           77           Ld (HL),A      119        77
Dec HL            43            2B           Djnz -4        16,252     10,FC
Djnz -4           16,252        10,FC        Ret            201        C9
```

Clue to clues

Simon Rapley,
Grantham,
Lincolnshire.

ZX-81

THIS PROGRAM is unusual in that it is unlikely to find the correct solution to an anagram. However, by repeatedly rearranging the letters of a string in a random order, then printing them to the screen, it may provide a visual clue to the solution of an anagram.

On a 16K machine, the program will unconditionally handle a string of up to 32 characters' length, including spaces. However, on an unexpanded machine, line 40 may have to be rewritten so that it reads as follows:

40 LET C$ = "C"

so that the display does not use up too much memory.

The generated strings are displayed on the screen, Scrolling as the screen becomes full. If key C is pressed, only one generated string will be displayed at a time.

```
  5 REM "ANAGRAM"
 10 REM "BY SIMON A. RAPLEY"
 15 REM "C 1982"
 20 LET N=0
 25 PRINT "LOAD LETTERS"
 30 INPUT B$
 35 CLS
 40 LET C$=INKEY$
 45 LET A$=B$
 50 LET T$=""
 55 LET L=LEN A$
 60 LET E=INT (RND*L)+1
 65 LET S$=A$(E)
 70 LET T$=T$+S$
 75 LET A$=A$( TO E-1) +A$(E+1 TO )
 80 IF A$="" THEN GOTO 90
 85 GOTO 55
 90 LET N=N+1
 95 IF C$="C" THEN LET N=1
100 IF N>22 THEN SCROLL
105 IF C$="C" THEN CLS
110 PRINT T$
115 GOTO 40
```

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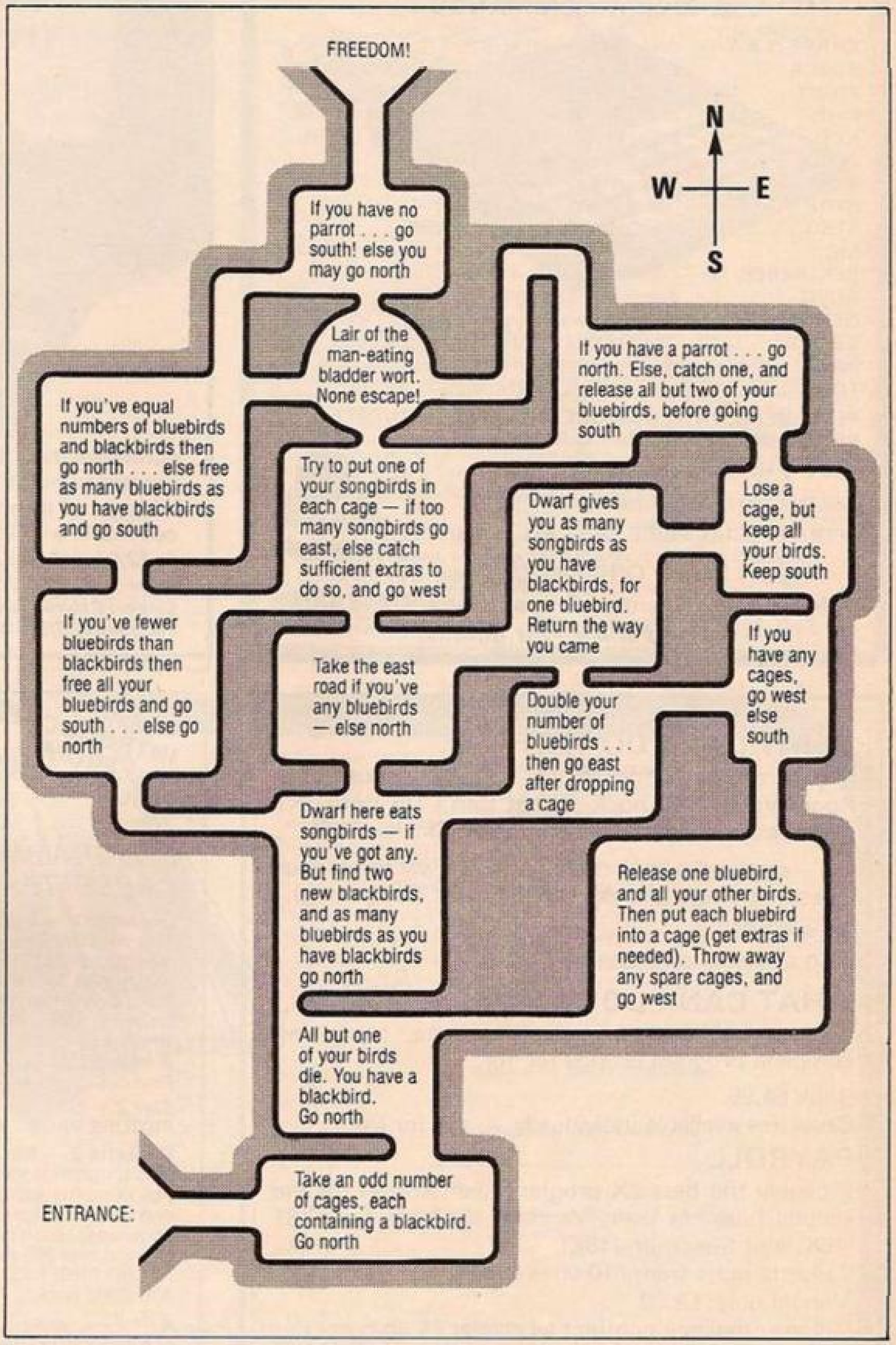
Bird catcher

BY ANTHONY ROBERTS

TO ESCAPE FROM the wizard one-eye, you must investigate his bird-filled dungeons. To start with, you must take three or more caged blackbirds from the first room — how many could you take and survive to reach freedom?

A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in July. The name of the winner, the solution, and a competition report will be published in the September issue of *Your Computer.*

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.



Competition results

THERE WAS A reduction in the number of entries for the Micro Gen joystick competition in May. But the standard of entries was as high as ever, making it extremely difficult to pick out a winner. However, after some deliberation, first place was awarded to Andrew Hay, Glendale, Salcombe Hill Road, Sidmouth, Devon EX10 8JS, who completed the sentence "I need a Micro Gen joystick for the ZX-81 because . . ." with "it will give me more joy and less stick". A Micro Gen joystick is on its way.

Other suggestions which caught the eye included Michael Jasztal's "My arthritic touch-sensitive keyboard cannot subdue hyper-active aliens" and Julian Stradling's "It refreshes the ports other joysticks cannot reach". R Henson explained that "My arrows are worn out" while Eric Lewis revealed "I wish to compute on a different plane".

David Appleyard said "It is a unique hands-on experience" and R Featherstone noted "I need to move around a byte". David Wakeling reported "My fingers can't fly fast enough" while S Kwiecien explained "My flight-simulator program doesn't feel right on a keyboard". D Babbage made a heart-felt plea with "The keyboard won't last much longer and the aliens are coming".

The solution to the Rodent Riddle competition in May is 13 collars. The equation you are trying to find is 'A' where 42=(9×6)baseA and 9×6 is 42 to base 13. If you want a program to give you a solution, the cave system itself is one — as with all these puzzles. Just interpret each cave as a statement. For instance, the cave "Giant preying mantis eats one of your black mice" is easily translated as

LET B=B

and "Troll gives you as many more white mice as you have grey mice" reads as

LET W=W+G

and so on.

The first correct answer pulled out of the hat belonged to Alan Temple of 46 Fleet Road, Holbeach, Spalding, Lincolnshire PE12 8LA, who used a Vic-20 to write the following program:

```
10 FOR C=1 TO 81
20 FOR I=6 TO 9 STEP 3
30 FOR J=6 TO 9 STEP 3
40 W=I*J: B=0: G=I+1
50 IF W C THEN B=B+1: W=W-C: GOTO 50
60 W=W+G*B
70 IF W=42 THEN ?"I=";:?I:?"J=";:?J:
   ?"W=";:?W:?"C=";:?C:
80 IF W=42 THEN STOP
90 NEXT J,I,C
```

C = number of collars; W = number of white mice; B = number of black mice; G = number of grey mice. ■

Solution to the May crossword.



ZX81 ECONOMIC KEYBOARD £11.95

Would you like an easy keyboard to use? Would you rather not pay £30 or so to get one? What you need is
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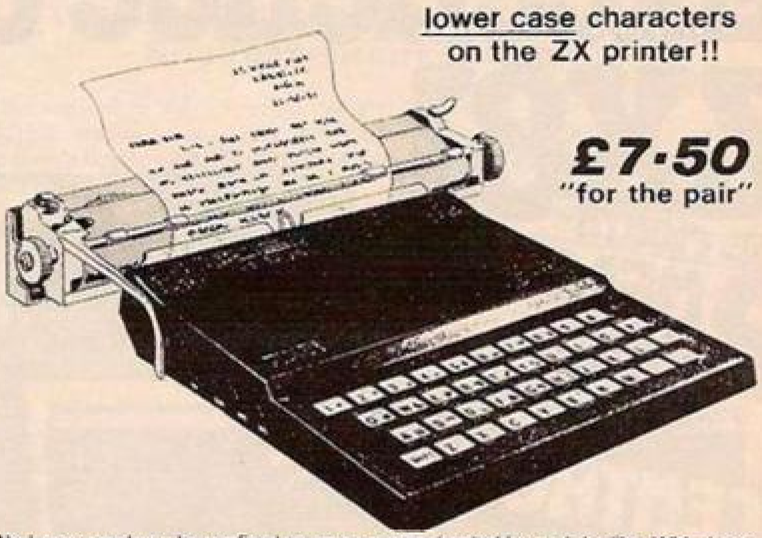
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lower case characters on the ZX printer!!



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Organic Micro

What do you do when you want to make your micro more powerful?
You add memory. Memory is the most expensive part of a microcomputer. For example, to increase a ZX81 from 1K to 16K of RAM costs over 70% the price of the micro itself. The rest of the cost is shared between the CPU, ROM, the circuit board, the case, the keyboard, the various plugs and sockets, as well as the manufacturing and marketing expenses.

What do you do when you grow out of your ZX81, ATOM or VIC?
Throw them away or give them to your kid, and buy a more powerful machine. All you really wanted was a new CPU and a new ROM, probably the least expensive bits of integrated electronics, and yet you have normally to replace everything. One way of tackling this redundancy problem is to have a system which uses a universal bus, such as the S100. The major cost of this type of mother board system is a big case full of sockets, and a large fan-cooled power supply to cope with future expansion. The case alone will cost more than, for example, a VIC or ATOM. Although such a system allows some versatility in plugging in various boards ranging from CPU to disc controller, and allows upgrading of the computer, it is fundamentally limited by both the finite number of expansion slots and the large initial outlay.

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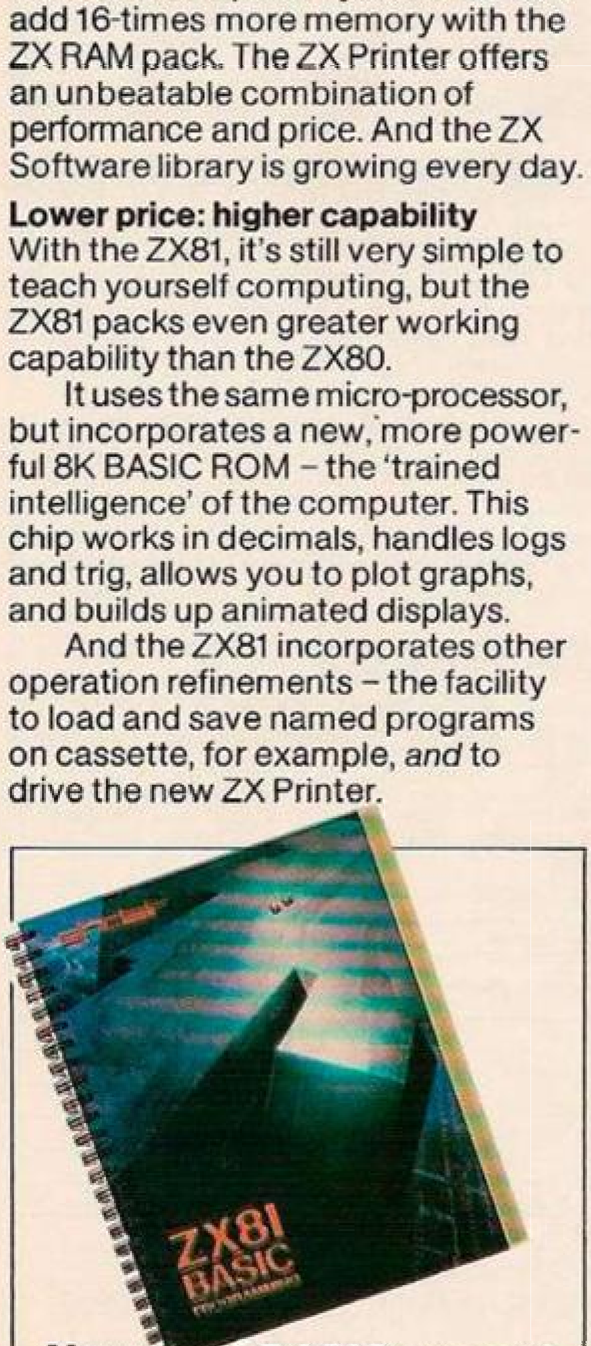
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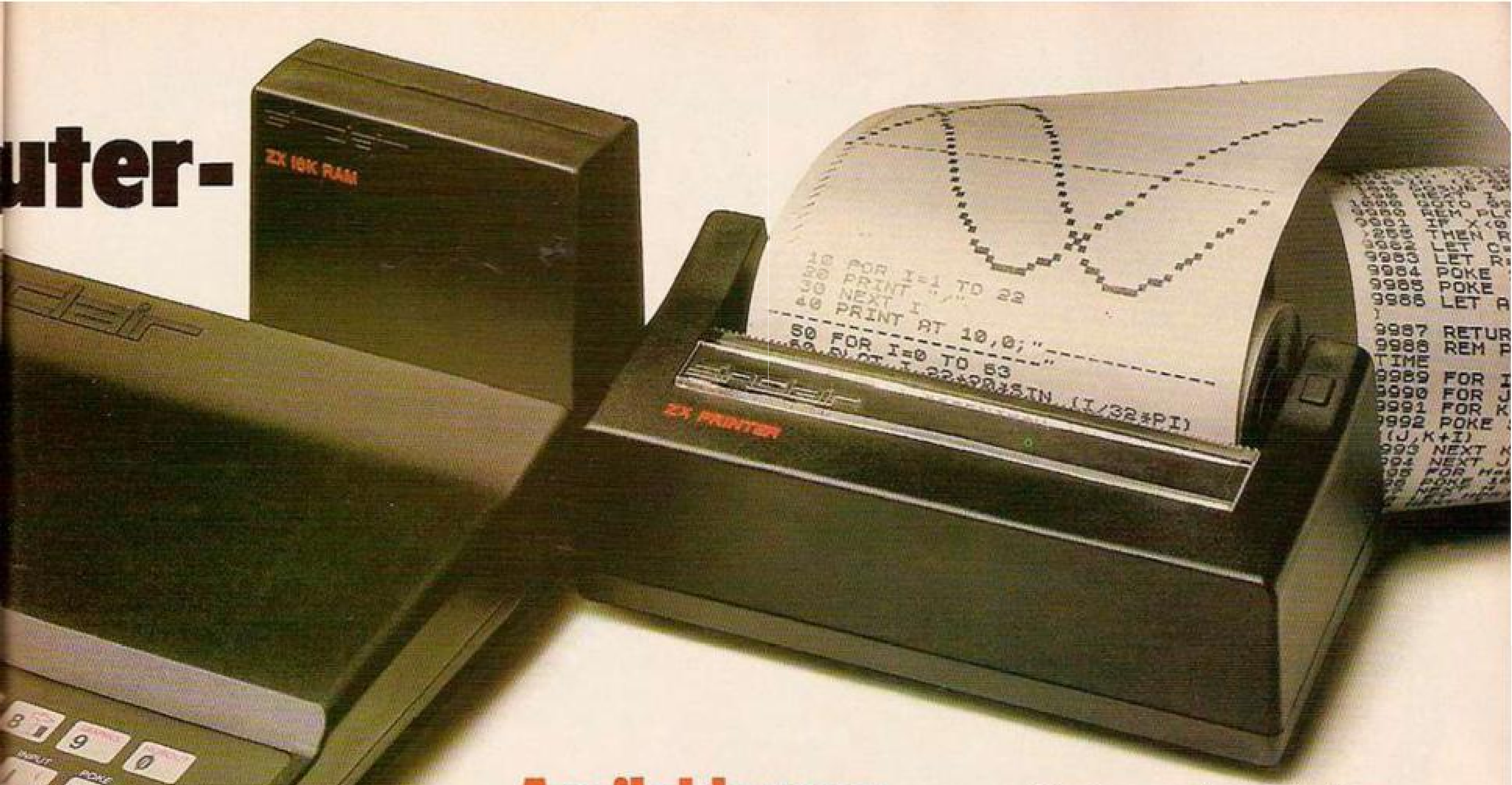
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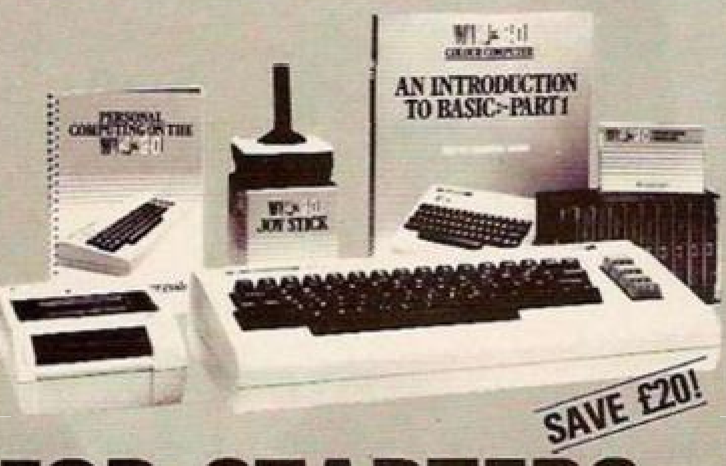
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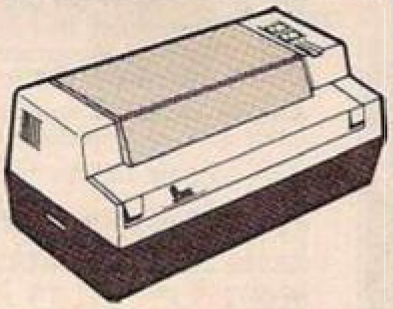
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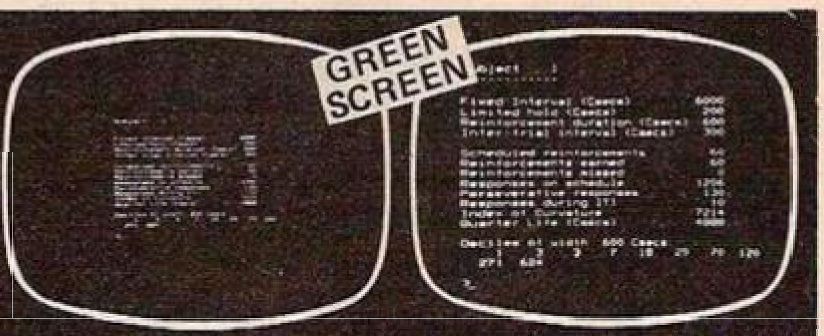
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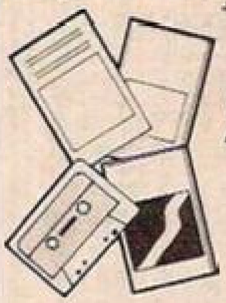
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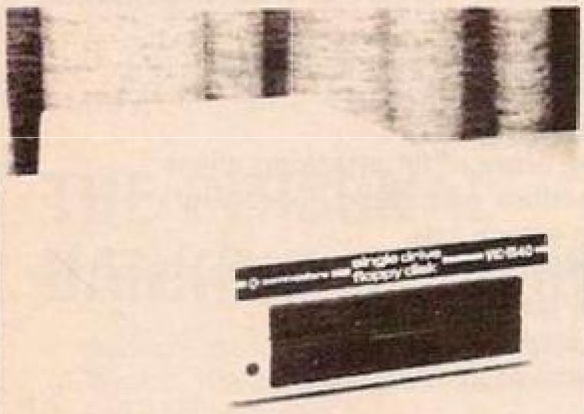
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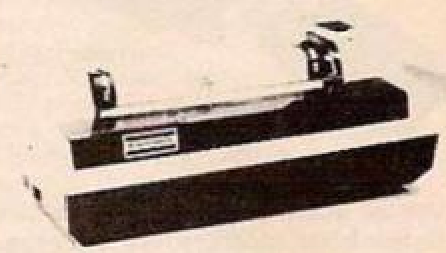
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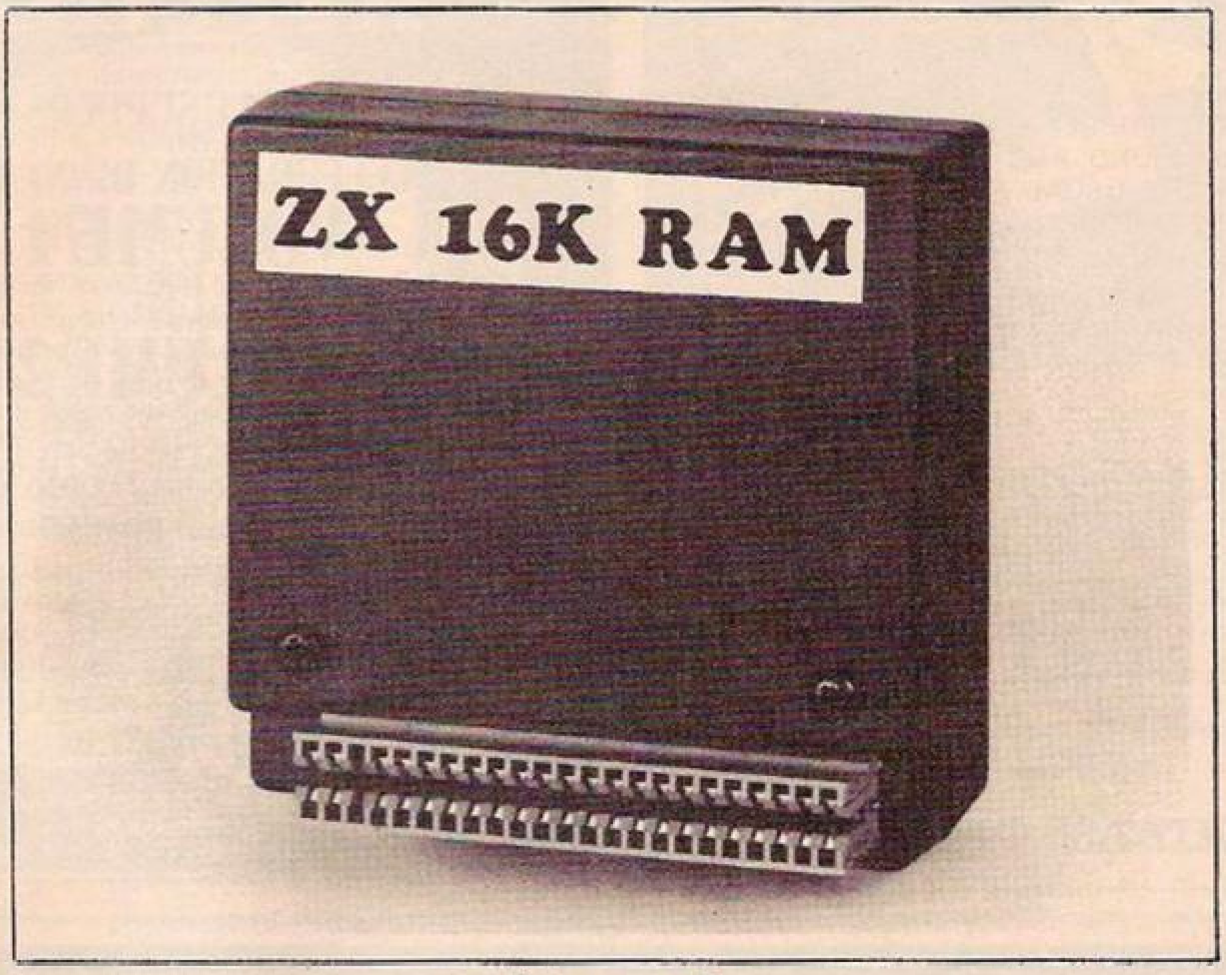
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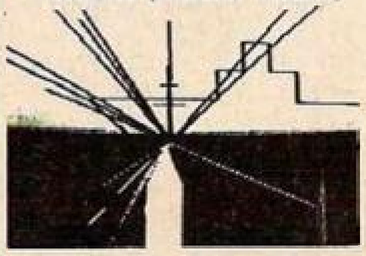
As soon as possible we shall be providing our customers with software for the Spectrum. We will be concentrating initially on video games and serious work. If you have any very good software, then we would be delighted to hear from you. If you are a dealer then why not ask about our dealers scheme. Most importantly, if you are an owner, then drop us a line, or give us a call, and we will bring you up to date.

SHOWROOM

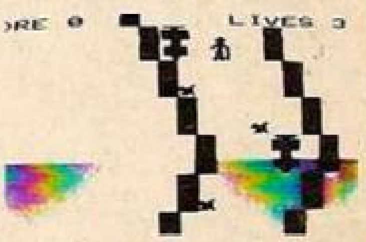
Opening shortly opposite Debdale Park, Gorton, Manchester.
All prices incl. VATR and p&p. Please send to:
CONTROL TECHNOLOGY, 39 Gloucester Road, Gee Cross, Hyde, Cheshire SK14 5JG (061-368 7558).

NEW RELEASE

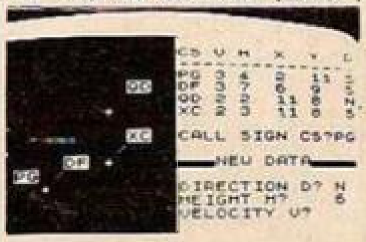
Trident (Acorn Atom)



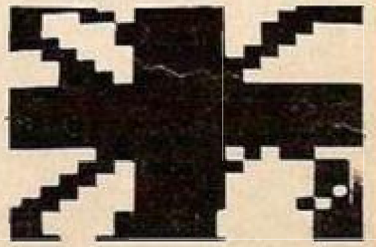
Death Race 2000 (Vic 20)



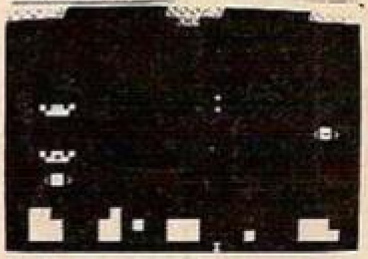
Air Traffic Control (ZX81)



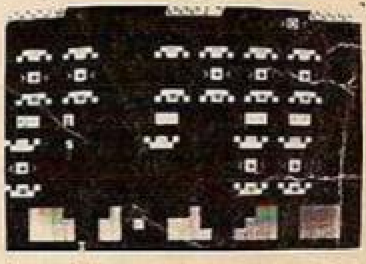
Warlords (Vic 20)



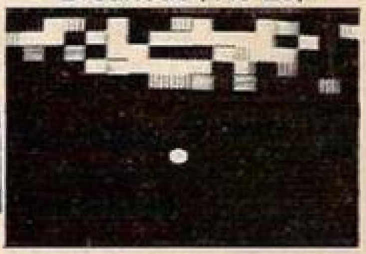
Space Invaders (ZX81)



Space Invaders (ZX81)



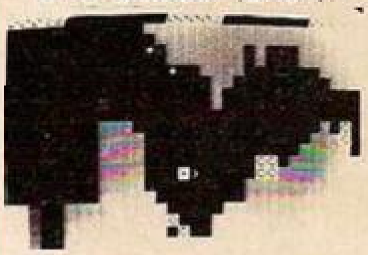
Breakout (Vic 20)



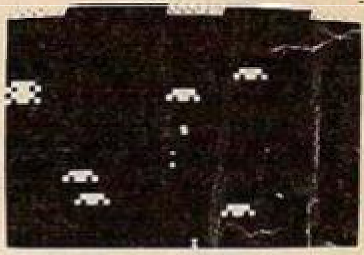
Draughts (ZX81)



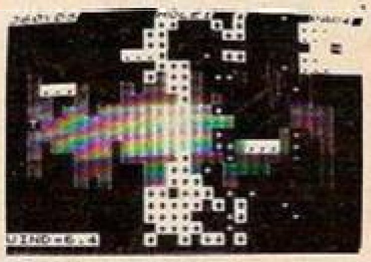
UFO Bomber (ZX81)



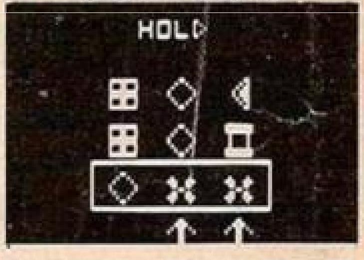
Galaxions



Handicap Golf (ZX81)



Fruit Machine (Acorn Atom)



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